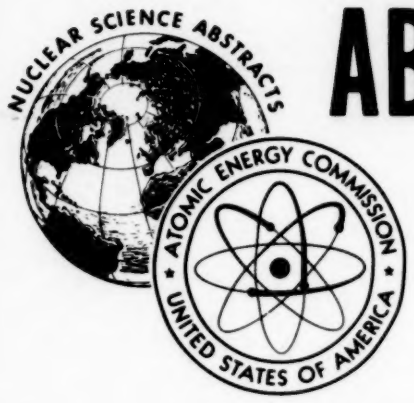
NUCLEAR SCIENCE ABSTRACTS



Volume 30 Number 9

Abstracts 23496-26327

November 15, 1974

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Volume 30, Number 9, November 15, 1974

NUCLEAR SCIENCE ABSTRACTS

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Published by the USAEC Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

SMITH, H., Planetary nebulae: two types, 29:13374
SMITH, H.R. Jr., Principles of electron beam technology, 29:13155
SMITH, J., See HOEGERMAN, S.F., 29:13035
See HOEGERMAN, S.F., 29:13037

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

REACTOR LICENSING/SPAIN
Harmonization of the licensing conditions including environmental protection for the siting of nuclear power plants, 29:14745
REACTOR MATERIALS/STRESS ANALYSIS
Problems on nuclear reactor structure at elevated temperature, 29:14654
REACTOR PROTECTION SYSTEMS
HTGR gas turbine power plant control and safety studies. Quarterly progress report for the period July 1, 1973--September 30, 1973, 29:14846 (GULF-GA-A-12799)

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Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

14452 (WASH-1278) CTR ENGINEERING SYSTEMS STUDY REVIEW MEETING, GERMANTOWN, MARYLAND, SEPTEMBER 19 AND 20, 1973. Gough, W. C. **(USAEC Division of Controlled Thermonuclear Research, Washington, D. C.).** 1973. 258p. (CONF-730971-). Dep. NTIS $7.60.

is indexed as:

USAEC DIVISION OF CONTROLLED THERMONUCLEAR RESEARCH, WASHINGTON, D.C.
CTR engineering systems study review meeting, Germantown, Maryland, September 19 and 20, 1973, 29:14452 (WASH-1278)

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Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

23496 47th NATIONAL COLLOID SYMPOSIUM, OTTAWA, ONTARIO, CANADA, JUNE 18–20, 1973. Washington, DC; American Chemical Society (1973). 120p. (CONF-730616-(Absts.)).

Analytical and Separations Chemistry

23497 PITTSBURGH CONFERENCE ON ANALYTICAL CHEMISTRY AND APPLIED SPECTROSCOPY, CLEVELAND, OHIO, MARCH 5–9, 1973. Abstracts. Pittsburgh; Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Inc. (1973). 168p. (CONF-730314-(Absts.)).

Abstracts of the 318 papers presented at the conference are included. (JGB)

23498 CHEMISTRY: PHYSICAL-CHEMICAL ANALYSIS METHODS. Besombes-Vailhe, J.; Villardry, P.; Mora, J. C.; Julien, E. Toulouse; Ecole Nationale Superieure de l'Aeronautique et de l'Espace (1972). vp. (In French).

This manual treats in a general way certain analytical techniques: spectroscopic emission; gas phase chromatography; mass spectrometry; atomic absorption; methods based on radioactivity, polarography, and rectification. (FR)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 23980, 23996, and 24068.

23499 (AERE-PR/NP-20, pp 55-57) NEUTRON CAPTURE γ-RAY STUDIES. Jarvis, O. N.; Sherwood, A. C.; West, D.; Whitehead, C. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1974.

23500 (EURISOTOP–18) SPECIAL MEASURING METHODS IN ACTIVATION ANALYSIS. Speecke, A.; De Soete, D. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). 1972. 69p. (In German). INIS.

A survey is given of the most common measuring methods of activation analysis. The methods are split into two groups: first, methods specific to the nuclear properties of the wanted isotope. These are various coincidence methods as well as decay curve analysis. Second, methods specific to special instrument equipment. Among these are spectrum stripping, mixed gamma spectrometry, Compton compensated spectrometers, and special detectors (wafers, semiconductors). A separate chapter deals with automatic activation analysis. The methods are described and illustrated by means of numerous application examples. (INIS)

23501 (IEA-TI–24) APPLICATIONS OF ACTIVATION ANALYSIS TO SOLVE PROBLEMS IN ARCHAEOLOGY AND ART. Vasconcellos, M. B. A. (Instituto de Energia Atomica, Sao Paulo (Brazil). Divisao de Radioquimica). Jan 1973. 18p. (In Portuguese). INIS.

The importance of the application of scientific analysis to the compositional and structural study of artistic and archaeological objects is discussed. Activation analysis is presented as one of the most adequate methods for this kind of study, due to the fact that the available specimens are generally small and the activation method is highly sensitive. Some compositional studies of several objects of archaeological interest, made of materials such as ceramic, glass, metal (mainly coins), bones and teeth are also presented, together with the conclusions drawn by the authors. A few papers about the study of pigments from paintings by activation analysis are described. In these studies, the concentration of trace elements in white lead, which is the principal components of all the pigments, is determined. Two papers about the structural study of paintings by neutron activation radiography are described. In these papers, some very interesting conclusions about the techniques employed by the painters are drawn. In the case of a painting by the American artist Ralph A. Blakelock, the authors present irrefutable evidence of forgery. Finally, a study of the regeneration of faded photographs by neutron activation radiography is related. (INIS)

23502 (IEN-DQ-RC–04) ANALYSIS OF OXYGEN TRACES IN STEELS BY ACTIVATION WITH 14 MeV NEUTRONS. Fulda, S. H. S.; Palino, G. F.; Bellido, A. V. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Dec 1972. 63p. (In Portuguese). INIS.

The development of a method for the determination of traces of oxygen in steels and other ferrous materials by activation analysis is described. The reaction $^{16}O(n,p)^{16}N$ was produced by 14-MeV neutrons using the neutron generator of the Instituto de Engenharia Nuclear. In order to carry out the irradiations and to measure the gamma activity of the ^{16}N produced, it was necessary to build a dual pneumatic system for rapid transfer, a sample rotation system, and an additional detection system for the reference sample (monitor). Some modifications in the operation and control of the neutron generator were also made. In the method adopted, calibration curves were first obtained by measuring induced activity as a function of oxygen concentration in a series of known standards. The unknown samples were irradiated immediately afterwards under the same conditions, and the induced activity was then used to calculate the oxygen content, using the slope of the calibration curve. Samples of oxygen levels certified by the National Bureau of Standards (U. S. A.) were used to test the accuracy of the method. From the results obtained, the conclusion drawn was that the method can be used, with good accuracy, above certain limits of concentration. Samples with lower levels of oxygen can also be measured, but with less accuracy. (INIS)

23503 (K-1-72) MERCURY DETERMINATION IN FISH COLLECTED FROM THE SEAS SURROUNDING TURKEY BY THERMAL NEUTRON ACTIVATION ANALYSIS. Olmez, I. (Ankara Nuklear Arastirma Merkezi (Turkey)). Oct 1972. 13p. (In Turkish). INIS.

Trace levels of mercury in fish were determined by thermal neutron activation analysis. Comparison of the amounts of mercury obtained from different species of fish living in different areas gave an indication of pollution of the sea from industrial sources. Amounts varying from 15.23 to 0.06 ppM of mercury per gram of dry dorsal muscle tissue were observed. (INIS)

23504 (K–2–73) DETERMINATION OF TRACE ELEMENTS IN AIR POLLUTION BY ACTIVATION ANALYSIS. Altan, T.; Kut, A.; Pamuk, F. (Ankara Nuklear Arastirma Merkezi (Turkey)). May 1973. 15p. INIS.

In addition to different gases, smoke and dust, several trace elements are continuously being introduced into the atmosphere by burning of coal, oil, and refuse. In this work some of these trace elements were determined by neutron activation analysis applying chemical separation technique. Many of the elements found are highly toxic ones. (INIS)

23505 ACTIVATION ANALYSIS AND THE POSSIBILITIES OF ITS APPLICATION IN THE INSTITUT BORIS KIDRIC, VINCA, YUGOSLAVIA. I. Draskovic, R. (Institut Boris Kidric, Vinca, Yugoslavia). Tehnika (Belgrade); 26: No. 4, 113-120(1972). (In French).

A review is given of studies in the area of activation analysis at the Institut "Boris Kidric". The following analyses were made: (1) determination of impurities in GeO_2 and metallic Ge (spectrographic purity) of foreign and domestic production; (2) determination of the radioactive purities of the radioisotopes ^{198}Au, ^{131}I, ^{14}C, ^{35}S, and ^{32}P; and (3) determination of the radioactivity ratio of $^{198}Au/^{199}Au$ as a function of the neutron flux. (tr-auth)

23506 DISTRIBUTION OF SOME ELEMENTS IN IRON METEORITES. Lavrukhina, A. K.; Lyul, A. Yu.; Pelekis, L. L. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 3, 3-11(1974). (In Russian).

Instrumental neutron activation analysis was used for determining Ni, Co, Cu, Au, As, Ga, and Ir in iron meteorites. Correlations between elements were discussed considering various models of element differentiation in solar nebula. (auth)

23507 DETERMINATION OF THE NITROGEN CONTENTS OF WHEAT GRAIN SAMPLES BY MEANS OF FAST NEUTRON ACTIVATION ANALYSIS. Sevimli, H.; Ozyol, H.; Barutcugil, E.; Dincer, S. (Ankara Nuclear Research Center). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 1, 15-21(Feb 1974).

The nitrogen contents of wheat grain samples were determined by the use of fast neutron activation analysis employing the reaction $^{14}N(n,2n)^{13}N$. Barley grain samples with known nitrogen contents were used as standards for the comparative activation analysis. As a result, the nitrogen amounts in fifteen varieties of wheat samples were found between $(2.69 \mp 0.10)\%$ and $(1.53 \mp 0.08)\%$. (auth)

23508 DETERMINATION OF TRACE ELEMENTS IN AIRBORNE PARTICULATE MATERIAL BY ACTIVATION ANALYSIS. Atlan, T.; Kut, A.; Kut, D.; Olmez, I.; Pamuk, F. (Ankara Nuclear Research Center). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 1, 39-44(Feb 1974).

Several trace elements are being continuously introduced into the atmosphere by burning of coal, oil, and refuse in addition to different gases, smoke, and dust. Some of these trace elements were determined by neutron activation analysis applying chemical separation and instrumental methods in Ankara air. Many of the elements found are highly toxic. (auth)

23509 DETERMINATION OF NITROGEN AND PHOSPHORUS IN RAW MATERIALS FOR ANIMAL FEEDS, USING FAST NEUTRON ACTIVATION ANALYSIS. Bibby, D. M.; Champion, H. M. (Univ. of the Witwatersrand, Johannesburg). Radiochem. Radioanal. Lett.; 18: No. 4, 177-184(21 Aug 1974).

The nitrogen and phosphorus contents of a series of raw materials used in animal feeds have been analyzed by 14-MeV neutron activation analysis. The results obtained compare well with those obtained by traditional methods, except for samples containing relatively high levels of inorganic nitrogen or silica. (auth)

23510 DOES BACKSCATTERING OF ^4He IONS BY NUCLEI OBEY THE RUTHERFORD CROSS-SECTION FORMULA. Ziegler, J.F.; Baglin, J.E.E. (IBM Research, Yorktown Heights, New York 10598). J. Appl. Phys. 45: No. 4, 1888-1890 (Apr 1974).

Implicit in the use of nuclear backscattering as a quantitative analytic tool is the accuracy of calculating cross sections using a classical Coulombic scattering formula (Rutherford cross section) which includes recoil effects, but ignores spin, nuclear size, electron screening, hard-sphere scattering, and any nuclear-force effects. The Rutherford cross section has not previously been verified experimentally for ions of ^4He (1-2.5 MeV) for targets of ^{16}O, ^{27}Al, and ^{28}Si. For ^{14}N, agreement has been found with an accuracy of about 5%. Our experimental results show that ^{27}Al and ^{28}Si have the Rutherford formula value ($\pm 1\%$), and ^{16}O is Rutherford from 1.4 to 2.4 MeV. ^{14}N appears to deviate by about 2% at energies from 1.2 to 2.2 MeV and by more beyond this energy band. (auth)

23511 NEUTRON ACTIVATION ANALYSIS OF THE TRACE ELEMENTS COBALT, IRON, RUBIDIUM, SELENIUM, ZINC, CHROMIUM, SILVER, CESIUM, ANTIMONY AND SCANDIUM IN SURGICAL SPECIMENS OF HUMAN BRAIN TUMORS. P. 1. Schicha, H.; Kasperek, K. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Medizin); Mueller, W.; Schroeder, R. (Koeln Univ. (F. R. Germany). Pathologisches Inst.). Beitr. Pathol.; 151: No. 3, 281-296(1974). (In German).

6 figs.; 1 tab.; 43 refs.

One hundred and twenty-one tissue samples were dissected from the human brain or the intracranial cavity, the most during operation; 92 samples were taken from histologically classified tumors, which were spongioblastomas, astrocytomas of grade I and II, oligodendrogliomas of grade I and II, glioblastomas, medulloblastomas, neurinomas, ependymomas, meningiomas, pituitary adenomas, one plexus papilloma and calcified tumors. As reference tissue 26 samples from cerebral cortex, medulla, and dura were taken. The trace element concentrations were measured by means of instrumental neutron activation analysis. In comparison to normal cerebral tissue some types of cerebral tumors showed increased contents of several essential trace elements; relatively high values were found for Rb, Se, and Zn in the glioblastomas and medulloblastomas, for Rb and Se in the neurinomas, for Rb in spongioblastomas, and for Zn in ependymomas. The pituitary adenomas showed the highest Fe content, the medulloblastomas and astrocytomas of grade I and II the lowest. Calcified parts of oligodendrogliomas had a threefold increased Zn-concentration in solid tumor portions whereas the other essential trace elements were decreased. An excessive increase of Co, Fe, Zn, Cr, and Ag was found in a partly calcified plexus papilloma. Similar to other tissues certain correlations between the essential trace elements Fe, Rb, Se, and Zn are also evident in brain tumors. In contrast to these essential elements the nonessential trace elements and the essential chromium showed no significant correlations; their concentrations exhibit great variations in all samples. Discussion: The results are compared with literature data. The question is discussed with what kind of reference tissue the investigated cerebral tumors have to be compared. In relation to normal cerebral cortex, brain tumors show generally increasing trace element concentration of Rb, Se, and Zn with increasing malignancy, whereas the Fe-content is decreased in malignant tumors. The possible mechanisms of trace element changes in cerebral tumors are discussed. (auth)

23512 INSTRUMENTAL ACTIVATION ANALYSIS. Application to Cosmic and Earth Substances. Osawa, M. (Tokyo Gakugei Univ., Koganei, Japan). Jap. Anal.; 22: No. 12, 1621-1635 (Dec 1973). (In Japanese).

Instrumental neutron activation analysis and its application to silicate minerals are reviewed. A number of elements show high sensitivity to thermal neutron irradiation. Al, As, Ca, Ce, Co, Cr, Cs, and other elements, which are often found in rocks, give sufficient sensitivity for analysis. The precision of determination is satisfactory. The analysis of neutron-activated seawater was used to compare detectors. Standard rocks, superbasic rocks, and other rocks were successfully analyzed after short-period or long-period irradiation. Lunar substances were analyzed by Ge(Li) γ spectrometry. Activation is used, for example, for the determination of Si and O by irradiation for 30 seconds at a neutron flux of 3×10^8 n/cm^2 sec with a delay time of 20 seconds. Also the automatic activation analysis to be practiced on the moon was mentioned. (JA)

23513 PRELIMINARY RESULTS WITH SATURABLE MICROCHANNEL ARRAY PLATES. Timothy, J.G. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory, 60 Garden Street, Cambridge, Massachusetts 02138). Rev. Sci. Instrum. 45: No. 6, 834-837 (June 1974).

Microchannel array plates with a performance comparable to that of a conventional channel electron multiplier have been obtained for the first time. These array plates employ an angled electrostatic field to inhibit the feedback of positive ions within the microchannels. Saturated output pulse height distributions with modal gain values in excess of 10^7 have been obtained and stable operation demonstrated over a range of ambient pressures from 1×10^{-7} to 8×10^{-5} Torr. However, a time-dependent reduction in the gain has been observed with these experimental plates because of the accumulation of charge on the insulating strips which are inserted in the wall of the microchannel to establish the angled electrostatic field. (auth)

23514 RAPID NEUTRON ACTIVATION ANALYSIS FOR GUNSHOT RESIDUE DETERMINATION. McFarland, R. C.; McLain, M. E. (Georgia Inst. of Tech., Atlanta). J. Forensic Sci.; 18: 226-231(Jul 1973).

Due to inherent contamination by sodium and other contaminants of the paraffin casts or cotton swabs used to collect the residues for NAA, the purely instrumental NAA approach has not proven practical; and radiochemical separations must be performed on the irradiated samples prior to counting. The radiometric method of chemical yield determinations in the post-irradiation radiochemical processing of gunshot residue samples gives comparable values for the chemical separations yields for barium and antimony. Furthermore, the time required for the separations is reduced from the former 90 minutes to less than 30 minutes in the case of the barium determination. Later experiments have demonstrated that additional savings in chemical separations time and effort can be realized by the centrifugation and direct counting of the Sb_2S_3 precipitate. The incorporation of the tagged carrier compensates for counting geometry differences

between the standards and the unknowns when the precipitated Sb_2S_3 is counted in the centrifuge tube after decanting the supernate and washing the precipitate to remove contaminants. Nonradioactive contaminants (for example, elemental sulfur) do not influence the radiometric yield determination as they do the conventional gravimetric method. (LK)

23515 DETERMINATION OF TRACE ELEMENTS IN CEYLON TEA BY MEANS OF ACTIVATION ANALYSIS. Shimkova, M.; Kukula, F. (Inst. of Nuclear Research, Rez, Czech.). Isotopenpraxis; 10: No. 6, 219-223(Jun 1974). (In Russian).

Neutron activation analysis and high-resolution γ spectrometry were used for determination of potassium, manganese, bromine, copper, nickel, aluminium, cobalt, zinc, and iron in various sorts of Ceylon tea. After irradiation of the samples with a neutron flux of 10^{13} n · cm^{-2} · s^{-1} in the core of a WWR-S reactor, all the additives except copper and nickel were determined by means of nondestructive analysis; copper and nickel were precipitated after mineralization with sodium diethyl dithiocarbamate or a mixture of the chelates of the arising reagents. The problem of the dissolution of the trace elements during tea preparation is described. (auth)

23516 CALCULATION OF THE MINIMUM CONCENTRATION AT ACTIVATION ANALYSIS UNDER OPTIMUM MEASURING CONDITIONS. Dimchev, T. (Inst. of Nuclear Research and Nuclear Energy, Sofia). Isotopenpraxis; 10: No. 6, 205-219(Jun 1974).

A theoretical model was worked out for the calculation of the minimum provable concentration at activation analysis under optimum measuring conditions. Expressions were drawn for calculation of the minimum activity, which can be proved for different lifetime of the obtained radionuclides and in relation to the background, the detection efficiency, the given statistical error or confidential probability, and the measuring time at our disposal. Formulas are given for optimum distribution of the measuring time at disposal. Expressions were drawn for preliminary estimation of the sensitivity of the activation determination in relation to: the cross section of the activation, the density of the activating flux, the isotope ratio, the sample weight, the activation times, rest, and measurement, the decay constant, the detection efficiency, the background, and the given statistical accuracy of the measurement. The expressions for the destructive as well as for instrumental analysis were drawn. The created model allows prediction of the sensitivity of the activation determination at unified criteria if the parameters characterizing the activation conditions and the measurement are known in any particular case. (auth)

23517 VARIATION OF TRACE ELEMENT CONCENTRATIONS IN SINGLE HUMAN HEAD HAIRS. Obrusnik, I. (Nuclear Research Inst., Rez, Czech.); Gislason, J.; McMillan, D. K.; D'Auria, J.; Pate, B. D. J. Forensic Sci.; 17: 426-439(Jul 1972).

This study has demonstrated the feasibility of measuring the concentrations of at least nine elements (Cr, Fe, Co, Zn, Sc, Ag, Sb, Au, Hg) in 10-cm segments of individual human hairs by the techniques of instrumental neutron activation analysis. No particular concentration differences were revealed between hairs in the anagen and telogen phases of the growth cycle. Of the elements studied, six showed hair to hair variations comparable in magnitude for that reported earlier for hair taken from the population at large. (auth)

23518 MAJOR ELEMENT ANALYSIS OF EXTRATERRESTRIAL ROCK SAMPLES WITH 14-MeV NEUTRONS. Teschke, F.; Waenke, H. (Max-Planck-Institut fuer Chemie, Mainz). Radiochem. Radioanal. Lett.; 18: No. 5, 331-340(21 Sep 1974).

A procedure for the major element analysis—including oxygen—of rock samples via 14-MeV instrumental neutron activation is described. A comparison of data on a lunar soil sample obtained in this way with those published by other authors using various analytical techniques proves the high accuracy of this method. New precise data on stone meteorites are reported and cosmochemical consequences discussed briefly. (auth)

Chemical and Spectral Procedures

23519 (DP-MS-73-44) APPLICATION OF ESCA TO THE ANALYSIS OF URANIUM SYSTEMS. Gorsuch, J. D.; Stewart, W. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1973. Contract AT(07-2)-1. 7p. Dep. NTIS $4.00.

The usefulness of the ESCA (electron spectroscopy for chemical analysis) technique was demonstrated for identifying the uranium compounds present in a complex mixture. The electron spectra of a variety of uranium compounds were recorded, and the binding energies of both the uranium (4f) and the counter ion electrons were measured. In addition to binding energy shifts as large as 1.2 eV for uranium in different oxidation states, significant shifts were also observed for uranium in the same oxidation state, but with different counter ions. The technique was applied successfully to analyze solid deposits formed by the reaction of uranium hexafluoride with various contaminants present in UF_6 experimental systems. (auth)

23520 (EPA-660/2-74-001) MULTIELEMENT ANALYSIS OF ENVIRONMENTAL SAMPLES BY SPARK SOURCE MASS SPECTROMETRY. Taylor, C. E.; Taylor, W. J. (Southeast Environmental Research Lab., Athens, Ga. (USA)). Jan 1974. 30p. GPO $0.65.

A spark source mass spectrometer that uses electronic detection and a dedicated data analysis system was applied to a survey-type trace analysis for chemical elements. Errors in the data system software were identified and corrected. Modifications to the system permit identification and quantitation of 72 elements at the part per billion level in water samples. (auth)

23521 (RT/FI-(74)24) AUTOMATIC DATA ANALYSIS IN THE MASS SPECTROMETER. Giannini, M.; Oliva, P. R.; Ramorino, M. C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Div. Affari Internazionali e Studi Economici). Apr 1974. 23p. (In Italian). Dep. NTIS (US Sales Only) $4.25.

A computer code for the off-line data reduction of mass spectra for uranium isotopic analysis is described. The computer code evaluates the peak heights after correction for ion current decay and for mass discrimination. (auth)

23522 (TRG-Report-2463) ANALYTICAL METHOD FOR THE TITRIMETRIC DETERMINATION OF PLUTONIUM USING CUPROUS CHLORIDE AS REDUCTANT. Davies, W.; Townsend, M. (UKAEA Reactor Group, Dounreay. Dounreay Experimental Reactor Establishment). Apr 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

A method is described for the determination of plutonium in solution containing a wide range of metal and non-metal ions. Cu(I) reduces the plutonium to the trivalent state, excess Cu(I) is removed and the amount of additional potassium dichromate titrant required to oxidize the plutonium to the tetravalent state using a potentiometric technique is measured. In determining plutonium in solution of fuel which has been irradiated to a high level, both technetium and iodine interfere. Procedures to remove these elements are incorporated in the method. (auth)

23523 (UCID-15407) DETERMINATION OF TRACE URANIUM IN SILVER. Smith, N. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Nov 1968. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

To determine microgram quantities of uranium in silver metal from diffusion studies, the uranium is separated by coprecipitation with iron, the iron extracted into chloroform, and the purified uranium determined colorimetrically or fluorometrically. Uranium from 0.15 ppM to several percent can be determined with a relative precision of 3 percent for 10 ppM and above. (auth)

23524 (UCID-16549) CHEMICAL ANALYSIS FOR THE GASBUGGY EVENT. General Chemistry Technical Note No. 266. Hill, J. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Apr 1968. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

Chemical analyses of the pre-shot rock taken from the Gasbuggy site were compiled. (auth)

23525 (UCID-16553) ERROR ANALYSIS OF THE METHOD FOR THE DETERMINATION OF URANIUM BY CONTROLLED-POTENTIAL COULOMETRY. Harrar, J. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jul 1974. Contract W-7405-Eng-48. 16p. Dep. NTIS $4.00.

The sources and magnitudes of the systematic and random errors associated with this method are outlined. A determination of uranium in solution is described in which the chemical and electrical calibrations of the coulometric instrument are pooled to calculate the quantity of uranium in the sample. These results are evaluated statistically. (auth)

23526 (UCID-16554) ERROR ANALYSIS OF THE METHOD FOR THE DETERMINATION OF PLUTONIUM BY CONTROLLED-POTENTIAL COULOMETRY. Harrar, J. E.; Magana, J. W.; Walden, J. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jul 1974. Contract W-7405-Eng-48. 11p. Dep. NTIS $4.00.

The sources and magnitudes of the systematic and random errors associated with this method are outlined. Calibration of the coulometric instrument by both chemical and electrical means is analyzed and the results obtained by the two techniques are compared statistically. (auth)

23527 AMPEROMETRIC TITRATION OF Lu AND Y WITH COMPLEXON III USING TWO INDICATOR ELECTRODES. Mark-

habaev, I. A.; Zhdanov, A. K. (Tashkent State Univ.). Dokl. Akad. Nauk Uzb. SSR; No. 10, 34-35(1973). (In Russian).

The results of biomperometric titration of Lu and Y showed the method to be precise and reproducible. Deviations of amounts found from the known amounts used were within the limits of levels of confidence, which indicates the absence of systematic errors. From 3 to 5 min is required for a sample. The method may be used for determination of other rare-earth elements. (TTT)

23528 SPECTROPHOTOMETRIC DETERMINATION OF THORIUM WITH THE REAGENT CHLOROPHOSPHONAZO III IN PHOSPHORIC ACID MEDIUM. Lukin, A. M.; Titov, V. I.; Chernyshova, T. V.; Evdokimova, N. N. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 10, 1536-1537(Oct 1973).

Translated from Zavod. Lab.; 39: No. 10, 1174-1175(Oct 1973).

A method was developed for the determination of thorium in monazite ore, containing not only thorium, but also phosphates, rare-earth elements, and small quantities of alkaline-earth elements. (LK)

23529 INVESTIGATION OF THE CONDITIONS OF BIAMPEROMETRIC TITRATION OF IRON IN CONJUNCTION WITH MOLYBDENUM, COPPER, AND CADMIUM. Usatenko, Yu. I.; Suprunovich, V. I.; Yamnova, T. P. (Dnepropetrovsk Chemico-Technological Inst., USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 10, 1538-1542(Oct 1973).

Translated from Zavod. Lab.; 39: No. 10, 1175-1180(Oct 1973).

Accelerated methods, based on amperometric titration with thioxine, were developed for the determination of iron in conjunction with Mo, Cu, and Cd in various industrial objects. (LK)

23530 DETERMINATION OF MICROCOMPONENTS OF NATURAL WATERS WITH PRELIMINARY GROUP CONCENTRATION BY ADSORPTION COMPLEXOMETRIC CHROMATOGRAPHY. Koganova, T. S.; Polyakov, V. A.; Kolotov, B. A.; Nechaeva, T. P. (All-Union Scientific-Research Inst. of Hydrogeology and Engineering Geology, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 10, 1550-1551(Oct 1973).

Translated from Zavod. Lab.; 39: No. 10, 1186-1188(Oct 1973).

A modified method of adsorption-complexometric chromatography in combination with emission spectral analysis was used for concentrating and determining the microcontents of the various elements present. The sensitivity of the analysis in μg/liter was: Cu, 0.07; Mo, 0.07; Bi, 0.02; Au, 0.07; Sn, 0.07; Pb, 0.07; Sb, 0.05; Cd, 0.02; and Zn, 1.8. The complex sorbent also effectively removes Ag, Ni, Co, Zr, Y, Yb, V, Tl, Mn, Ga, Be, B, and As. (LK)

23531 ALTERNATING CURRENT POLAROGRAPHIC DETERMINATION OF URANIUM IN COMPLEX MINERALS CHARACTERIZED BY ELECTRON PROBE ANALYSIS. Bond, A. M. (Univ. of Melbourne); Biskupsky, V. S.; Wark, D. A. Anal. Chem.; 46: No. 11, 1551-1558(Sep 1974).

Polarographic methods generally do not have the required specificity for undertaking the direct determination of a particular element in complex systems such as those encountered in geochemical analysis. In this work, it is shown that phase-selective high frequency ac polarography enables the determination of uranium in extremely complex minerals such as euxenite, samarskite, thorite, thorianite, and monazite and in glasses without the usually required separation procedures. The minerals are completely characterized by electron probe data to show the wide range of other elements tolerable. The attempted determination of uranium by atomic absorption spectrometry, x-ray fluorescence, and fission track analysis is also reported. The difficulties encountered in these methods because of the large matrix corrections required, or other reasons, demonstrate the usefulness of the proposed polarographic method. The specificity, not usually attributed to polarography, results from the ability of the high frequency ac method to discriminate against nonreversible electrode processes and species reduced at more positive potentials than uranium. However, high quality polarographic instrumentation is needed as the use of the conventional two-electrode cell arrangement can give rise to undesirable instrumental artefacts, possibly explaining previously reported interferences. (auth)

23532 DETERMINATION OF TRACE AND ULTRA-TRACE QUANTITIES OF RARE-EARTH ELEMENTS BY ION EXCHANGE CHROMATOGRAPHY–MASS SPECTROGRAPHY. Strelow, F. W. E.; Jackson, P. F. S. (CSIR, Pretoria). Anal. Chem.; 46: No. 11, 1481-1486(Sep 1974).

Trace (1 to 1000 ppM) and ultra-trace (<1 ppM) amounts of lanthanides can be determined in heterogenous matrixes such as rock materials down to concentrations of less than 0.001 ppM using separation by cation exchange chromatography followed by determination with spark source mass spectrometry. Tests with a solution containing 10 nanograms of La, Ce, and Lu gave recoveries of 99 ± 7% while the other lanthanides were at or below the detection limit of about 0.5 nanogram. Results for all the lanthanides in several standard rocks including the dunite DTS-1 and the peridotite PCC-1 are presented, together with typical elution curves and details of the mass spectrometric procedure. (auth)

23533 AUTOMATED ATOMIC ABSORPTION DETERMINATION OF As, Sb, AND Se IN NATURAL WATERS. Goulden, P. D.; Brooksbank, P. (Canada Centre for Inland Waters, Burlington, Ont.). Anal. Chem.; 46: No. 11, 1431-1436(Sep 1974).

A method is described for the determination of sub-microgram levels of antimony, arsenic, and selenium in natural waters. Stibine, arsine, and hydrogen selenide are produced from the samples in an automated system and passed to a tube furnace mounted in the light path of an atomic absorption spectrophotometer. The use of a tube furnace as a covalent hydride decomposition device gives an increase in sensitivity over a conventional hydrogen–argon-entrained air flame of at least two orders of magnitude. The method will analyze 40 samples an hour with a limit of detection of 0.1 μg/l for arsenic and selenium and 0.5 μg/l for antimony. With a dual-channel spectrophotometer, simultaneous determinations of arsenic and selenium have been made on a large number of natural water samples. (auth)

23534 VITREOUS CARBON FURNACE WITH CONTINUOUS SAMPLE INTRODUCTION FOR ATOMIC FLUORESCENCE SPECTROMETRY. Molnar, C. J.; Winefordner, J. D. (Univ. of Florida, Gainesville). Anal. Chem.; 46: No. 11, 1419-1422(Sep 1974).

Atomic vapor of several metals (Sn, Pb, Te, Ag, Tl, and Bi) was produced by pneumatic nebulization of an aqueous sample through a vitreous carbon tube furnace, and atomic fluorescence was excited with single element electrodeless discharge lamps. The high efficiency of the system is discussed along with precision, sensitivity, linear dynamic range, and limits of detection for the elements examined. The decay of atomic populations above the furnace outlet using either an Ar-H_2 diffusion flame sheath or an Ar sheath is determined, and the results are discussed. (auth)

23535 APPLICATION OF A DEMOUNTABLE HOLLOW CATHODE LAMP AS A SOURCE FOR THE DIRECT DETERMINATION OF S, I, As, Se, AND Hg BY ATOMIC ABSORPTION FLAME SPECTROMETRY. Kirkbright, G. F.; Wilson, P. J. (Imperial Coll. of Science and Tech., London). Anal. Chem.; 46: No. 11, 1414-1418 (Sep 1974).

A water-cooled demountable hollow cathode lamp has been investigated as a source for the elements, S, I, As, Se, and Hg. The high emission intensity, good signal-to-background and signal-to-noise levels observed, permit use of this type of source for flame atomic absorption spectrometry of these elements in the nitrogen shielded nitrous oxide–acetylene or air–acetylene flames at their resonance lines below 200 nm. Self-absorption line broadening from these sources is minimized for the volatile elements at the low cathode temperatures and operating currents employed and using a continuous purge of argon at low pressure; favorable AAS sensitivities and detection limits are obtained, compared with corresponding microwave excited electrodeless discharge lamp sources. (auth)

23536 ACCURATE DETERMINATION OF TEN MAJOR AND MINOR ELEMENTS IN SILICATE ROCKS BASED ON SEPARATION BY CATION EXCHANGE CHROMATOGRAPHY ON A SINGLE COLUMN. Strelow, F. W. E.; Liebenberg, C. J.; Victor, A. H. (National Chemical Research Lab., Pretoria). Anal. Chem.; 46: No. 11, 1409-1414(Sep 1974).

A method is developed for the quantitative separation and accurate determination of Al, total Fe, Ti, Ca, Mg, Mn, Na, K, V, and Zr in synthetic mixtures and applied to silicate rock samples. Only a single column of AG 50W-X8 sulfonated polystyrene cation exchange resin is used and the elements are eluted by stepwise changing eluting agents. Ti(IV) and Zr appear in the same eluent fraction, but can be determined spectrophotometrically without interference. All other elements are completely separated from each other and determined very accurately by selected known analytical procedures. Recoveries for major amounts are 100.0 ± 0.1% or better for Al, Fe, Ca, Mg, Mn, and V and 100.0 ± 0.2% or better for Ti, Na, and K. Recoveries for Zr are only about 98% because Hf is not eluted together with Zr. Relevant distribution coefficients, elution curves, results for two synthetic mixtures and six standard rock samples, and a method for the separation of trace amounts of V in rocks from accompanying impurities are presented. (auth)

23537 SECONDARY ION MASS SPECTROMETRY OF RARE EARTH ELEMENTS. Ishizuka, T. (Government Industrial Research Inst., Nagoya, Japan). Anal. Chem.; 46: No. 11, 1487-1491(Sep 1974).

The secondary ion mass spectrometric studies of rare earth elements were performed by using Ar^+ ions. In the mass spectra of the various compounds containing the element oxygen as a com-

ponent, the intense ionic species were M^+ and MO^+. The intense species from the fluorides were M^+, M^{2+} and MF^+. The relative ion intensities of rare earth elements in aluminum oxide, yttrium oxide, and yttrium fluoride matrixes were comparable to that of aluminum. The detection limits for those elements ranged from 0.02 to 0.3 ppM (weight) in an aluminum oxide matrix. The analytical curves for several rare earth elements in yttrium oxide or fluoride matrix were linear in the concentration range of 0.01 to 30% (weight)—i.e., four orders of magnitude. The precision (relative standard deviation) in the analytical curves was 6.9 to 2.3% at the minor concentration (0.01 to 0.3%) and 3.2 to 0.5% at the major concentration (1.0 to 30%). (auth)

23538 TECHNIQUES FOR TRACE ELEMENT ANALYSIS: X-RAY FLUORESCENCE, X-RAY EXCITATION WITH PROTONS, AND FLAME ATOMIC ABSORPTION. Wheeler, R.M.; Liebert, R.B.; Zabel, T.; Chaturvedi, R.P.; Valković, V.; Phillips, G.C. (T. W. Bonner Nuclear Laboratories, Rice University, Houston, Texas 77001); Ong, P.S.; Cheng, E.L.; Hrgovcić, M. Med. Phys. 1: No. 2, 68-71 (Mar 1974).

Trace element concentrations in human blood serum have been measured by x-ray fluorescence and by x-ray excitation with protons to test the current effectiveness of each technique for routine analysis of biological samples. Results are compared with those obtained from analysis by flame atomic absorption. (auth)

23539 POLAROGRAPHIC CHARACTERISTICS OF MOLYBDENUM(VI) IN THE PRESENCE OF HYDROXY ACIDS. Ivanova, Z. I.; Chernikova, E. N.; Lektorskaya, N. A. (Rostov State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 7, 985-988(1974). (In Russian).

The polarographic characteristics of Mo(VI) in a background of lactic, glyceric, trioxyglutaric and mandelic acids were studied. On the basis of the results obtained a method was proposed for the determination of Mo in high-alloy steel in a background of trioxyglutaric acid. The sensitivity of the method is 1.0×10^{-5} mol/l. The relative error of the determination is 2.8%. (tr-auth)

23540 DETERMINATION OF MICROTRACES OF ZIRCONIUM IN NICKEL AND COBALT SALTS BY CONCENTRATION WITH COPRECIPITATION. Chuiko, V. T.; Chmilenko, F. A.; Smirnaya, V. S. (Dnepropetrovsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 7, 982-984(1974). (In Russian).

Microtraces of Zr were quantitatively coprecipitated with the arsenates of Ni and Co from solutions of salts of these metals. On this basis a method was developed for the determination of Zr traces (1×10^{-6}%) in salts of Ni and Co and their purification from Zr up to $n \times 10^{-5}$%. The Zr was determined by the photometric method with arsenazo III in 9 N HCl. (tr-auth)

23541 METHOD OF MEASURING THE ABUNDANCE RATIO OF ^{235}U AND ^{238}U. Tsutsumi, K. I. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan); Asakura, Y.; Shimomura, T.; Imai, S.; Yamanouchi, H. Ohm (Elec. Mag.); 60: No. 13, 86-90(Dec 1973). (In Japanese).

For the enrichment of ^{235}U from natural uranium the content ratio of ^{235}U and ^{238}U is often measured in the course of the enrichment process. The abundance ratio of the isotopes were first measured by A. O. Nier by the use of a mass spectrometer. He reported that the ratio $^{238}U/^{235}U$ was equal to 139 ± 1% and the ratio $^{238}U/^{234}U$ was equal to 17,000 ± 10%. At present the ratios are measured by mass spectroscopy, emission spectrochemical analysis, and radiation spectroscopy. Of these, the last one makes use of the α-rays, β-rays or γ-rays. Only as the radiation of uranium is weak, this method does not give satisfactory data. The demerits of the mass spectroscopy are that the apparatus is costly though this method gives accurate results, and it takes a long time for the analysis. The emission spectroscopy is just the intermediate of the other two methods. A modification of this method was developed recently. According to this method, a cathodic discharge is adopted as a light source. For the spectroscopy, a diffraction grating spectrograph and a Fabri-Perot interferometer are used. High resolution is then obtained. Uranium is used as a sample electrode. In this case the choice of the uranium compound was the most important to obtain stable emission rapidly. For this purpose, trials were made by compacting uranium oxide and metallic aluminum powder to form a pellet. This compact was then sintered in a mixture of an inert gas and a reducing gas. The product gave a satisfactory electrode, which gave stable emission within 10 minutes. The repetition error was less than 0.3% for ^{235}U. Practical examples of the determination of the ratio by this method were given. (JA)

23542 DETERMINATION OF IODINATED COMPOUNDS IN BLOOD. I. Determination of Protein-Bound Iodine. Bednar, J.; Nemec, J.; Roehling, S.; Havelka, J.; Soutorova, M. (Research Inst. of Endocrinology, Prague). Cesk. Farm.; 22: No. 9, 400-403(1973). (In Czech).

A comparison is presented of manual and automated (Auto-Analyzer) methods based on alkaline decomposition of the sample and colorimetric determination of the resulting I^- by the As^{III}–Ce^{IV} reaction. Both methods gave satisfactory results. (Anal. Abstr.)

23543 CONDUCTOMETRIC DETERMINATION OF TRACES OF CARBON IN URANIUM DIOXIDE. Tomasevic, M. Tehnika (Belgrade); 25: No. 4, 122-126(1971).

A conductometric method for the determination of carbon in uranium dioxide was developed. The samples of UO_2 were burned in a stream of oxygen, at 1200°C in the induction furnace. CO_2 was adsorbed in 0.002 N $Ba(OH)_2$ in the conductometric cell. If the uranium dioxide contains fluorine in concentrations ≥100 ppM, lead oxide must be added to the samples before the ignition, so that nonvolatile PbF_2 will be formed. (Bull. sci. Sect. A Yougosl.)

23544 DETERMINATION OF U(VI) MICROAMOUNTS BY INDICATOR REACTION OF REDUCING VICTORIA BLUE WITH Ti(III). Pilipenko, A. T.; Pavlova, V. K. (Inst. of General and Inorganic Chemistry, Kiev). Zh. Anal. Khim.; 29: No. 6, 1165-1169(Jun 1974). (In Russian).

Reduction of Victoria Blue with titanium(III) in the presence of U(VI) microamounts proceeds via formation of several intermediate complexes. The results of the study of the reaction kinetics were used to develop an improved procedure of kinetic determination of uranium(VI) with a sensitivity of $4 \cdot 10^{-3}$ μg/ml. (auth)

23545 CHEMICAL-SPECTROGRAPHIC DETERMINATION OF THE NOBLE METALS USING SULFIDES AS INORGANIC COLLECTORS. Pavlenko, L. I.; Malofeeva, G. I.; Simonova, L. V.; Andryushchenko, O. Yu. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 29: No. 6, 1122-1129(Jun 1974). (In Russian).

The possibility is shown of group concentration of Pd (5×10^{-4}%), Pt (5×10^{-4}%), Rh (5×10^{-3}%), Ru (5×10^{-3}%), and Ir (1×10^{-2}%) by means of precipitation from hydrochloric acid solution in the presence of Co, Ni, and Fe (50 mg) using HgS, CuS, Sb_2S_3, and Bi_2S_3 as the carriers. The use of CuS makes it possible to separate the platinum metals from milligram amounts of copper. Distilling off Hg and Sb as bromides enables pure concentrates of the platinum metals to be obtained. It has been shown that hydrogen sulfide can be replaced by thioacetamide on taking CuS as an example. A chemical-spectrographic method is suggested for determining the percentage of Pt (5×10^{-6}), Pd (5×10^{-6}), Rh (5×10^{-5}), Ru (5×10^{-5}), Ir (2×10^{-4}), Au (2×10^{-6}) in the presence of milligram amounts of Co, Ni, Fe, Cu. The separation and concentration is carried out by coprecipitation of the platinum metals with CuS from hydrochloric acid solutions. The relative error is not more than 44%. (auth)

23546 USE OF MOLYBDOVANADOPHOSPHORUS COMPLEX FORMATION FOR POLAROGRAPHIC DETERMINATION OF Mo. Fortune, L. A.; Nguen van Cheu; Polotebnova, N. A. (Kishinev State Univ.). Zh. Anal. Khim.; 29: No. 6, 1118-1121(Jun 1974). (In Russian).

Molybdovanadophosphorus acids containing 1, 3, and 4 vanadium atoms are reduced on a mercury dropping cathode in pentanol solution using 1 N H_2SO_4 as the supporting electrolyte. The polarograms show a reduction wave, $E_{\frac{1}{2}} = -0.3$, which is a function of complex concentration in the solution. The reduction is irreversible and limited by diffusion. The ratio of the initial components needed for the formation of a complex with Mo : V : P = 8 : 4 : 1 has to be not less than 1 : 1.5 : 1. The complex formation in solution can be used for polarographic determination of molybdenum in steel by the reduction wave of the 8 Mo–4V–P complex in pentanol solution. The method sensitivity is 0.02 mg Mo in 1 ml. (auth)

23547 SPECTROPHOTOMETRIC STUDY OF THE COMPLEX OF Ce(III) WITH DIETHYLENETRIAMINEPENTAACETIC ACID AND BENZTHIORONIUM AND ITS APPLICATIONS IN ANALYSIS. Kirillov, A. I.; Turkina, L. A.; Vlasov, N. A. (Irkutsk State Univ., USSR). Zh. Anal. Khim.; 29: No. 6, 1226-1229(Jun 1974). (In Russian).

Complex formation between Ce(III) and diethylenetriaminepentaacetic acid was studied spectrophotometrically. The metal-to-reagent ratio was found to be 1 : 2. Mixed complexes of Ce(III) are formed in the presence of benzthiuronium, which are extracted into butyl and other high alcohols. The optimal pH is 8. The component ratio in the mixed complex Ce : H_5P : BTU is 1 : 2 : 4. An extraction-spectrophotometric procedure was developed of determining Ce(III) in mixtures of rare earth oxides with a sensitivity of 0.8 μg Ce/ml. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 23744, 23987, 23990, 23998, 24051, and 24395.

23548 (AAEC/E-314) ANALYSIS OF DILUTE NATURAL URANIUM SOLUTIONS BY GAMMA-RAY EXCITED X-RAY FLUORESCENCE. Ryan, R. K.; Ridley, J. L.; Alfredson, P. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1974. 31p. Dep. NTIS (U. S. Sales Only) $4.75.

Application of a gamma-excited X-ray fluorimeter to batch analysis of uranium solutions containing less than 10 g l^{-1}, and particularly of dilute impure solutions, is described. An outline is given of design details of the gamma-excited X-ray source and of the comparison of backscattered incident X-rays and fluorescent X-rays as a means of compensating for variations in the matrix solution. For pure solutions the lower limit of detection was 0.03 g l^{-1}, compared with 0.05 g l^{-1} for typical impure solutions. In the range 0.1 to 10 g l^{-1}, an accuracy of ±5 per cent was obtained, while in the range 0.05 to 0.1 g l^{-1}, the accuracy was ±30 per cent. (auth)

23549 (AAEC/E-319) SPECT: A FORTRAN PROGRAM FOR THE ANALYSIS OF TECHNETIUM-99m AND OTHER GAMMA SPECTRA IN A RADIOISOTOPE QUALITY CONTROL ENVIRONMENT. Hetherington, E. L. R.; Wood, N. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1974. 23p. Dep. NTIS (U. S. Sales Only) $4.25.

The FORTRAN program SPECT was written for use in a radioisotope quality control environment to process gamma spectra for the estimation of specific impurities in a radiopharmaceutical product. The analysis is performed using a radionuclide library containing details of the principal radioisotopes, expected impurities, and known spectrum artifacts. The program provides a plot of the spectrum on which significant peaks are marked. The activities of identified radioisotopes are calculated from principal emission and decay data contained in the library. The program output lists these activities, together with artifact peaks of known origin and details of unidentified peaks. The program requires <70K of storage and is used with the IBM 360/50 computer. (auth)

23550 (AERE-PR/NP-20, pp 54-55) HYDROGEN CONTENT DETERMINATIONS. Jarvis, O. N.; Sherwood, A. C. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1974.

23551 (IEA-330) X-RAY FLUORESCENCE BY RADIOISOTOPIC EXCITATION: A PROMISING ANALYSIS TECHNIQUE. Agudo, E. G.; Santos, M. E. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Apr 1974. 11p. (In Portuguese). Dep. NTIS (US Sales Only) $4.00.

The actual possibilities of a portable x-ray analyzer for copper determination in different mineral matrices are shown. The response is linear for copper in the range 0 to 50% Cu O in carbonate matrix, and nonlinear for silicates and hematite. The detection limit, with a 3 mCi ^{109}Cd excitation source was 0.05% CuO, but the results for low concentrations were strongly affected by the matrix composition, so the portable x-ray analyzer seems not appropriate for copper prospecting because of the very low concentration found in the field. The portable x-ray analyzer seems to be specially useful in mine work, were semiquantitative results can be obtained within 20 seconds, and also for "on stream" analysis in mineral processing plants. The low cost of the analyzer and the possibilities of continuously recording the concentrations in different points of processing plants, make this technique a very promising one for process control studies. (auth)

23552 (JEN-280) DETERMINATION OF ^{230}Th (IONIUM) IN URANIUM ORES AND WASTES FROM URANIUM REPROCESSING. IV. Calculation of Ionium Separation Yield. Galiano Sedano, J. A.; Acena Barrenechea, M. L. (Junta de Energia Nuclear, Madrid (Spain)). 1974. 19p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

For determining ionium (^{230}Th) in minerals and uranium processing wastes by precipitation with hydrofluoric acid, using lanthanum as a carrier, and selective extraction with thenoyltrifluoroacetone (TTA) followed by radiometric determination of the isolated nuclide, it is necessary to use a tracer since the chemical yield of the separation has a wide range. The use of the beta-emitter ^{234}Th as the most convenient tracer is discussed. Equations are derived for correcting the counting errors introduced by other thorium isotopes which are present either in the sample or in the tracer, as well as for calculating the chemical yield of the separation. These equations have been experimentally checked by ionium determinations carried out with different types of samples. (auth)

23553 (LA-5627) PREPARATION OF WORKING CALIBRATION AND TEST MATERIALS FOR INTRA- AND INTERLABORATORY SURVEILLANCE OF NUCLEAR MATERIALS MEASUREMENT METHODS: PLUTONIUM NITRATE SOLUTION. Swanson, G. C.; Rein, J. E.; Marsh, S. F.; Waterbury, G. R. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 18p. Dep. NTIS $4.00.

Methods for preparation of working plutonium nitrate calibration and test material (CTM) solutions similar to typical nuclear fuel cycle solutions are described. These working CTM solutions are to be used in calibrating and providing quality control surveillance of analytical methods for measurement of plutonium assay and isotopic abundances. Source materials are prepared from NBS plutonium certified reference materials, highly pure plutonium metal, or plutonium nitrate obtained from a plant inventory. Some solutions are prepared for assay measurement only, some for isotopic abundance measurement only, and others for both purposes. Procedures are described for their packaging and storing as evaporated slurry, solution for short-term storage, and solution for long-term storage. Analytical overcheck and characterization procedures are suggested, and statistical tests to assess the reliability of the working CTM solutions are given. (auth)

23554 (LBL-2951) X-RAY INDUCED X-RAY FLUORESCENCE ANALYSIS OF SUSPENDED AIR PARTICULATE MATTER. Giauque, R. D.; Goda, L. Y.; Garrett, R. B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1974. Contract W-7405-eng-48. 60p. Dep. NTIS $5.45.

Critical aspects of x-ray-induced x-ray fluorescence analysis that should be considered for quantitative elemental analysis of suspended air particulate matter are reviewed. Included are considerations that influence sensitivity and precision in x-ray fluorescence analysis using semi-conductor detector spectrometers. The analytical capabilities of spectrometers employed during these studies will be illustrated. Also, a method employed to compensate for particle size effects when analyzing for lower atomic number elements is discussed. (auth)

23555 (SGAE-2150) EVALUATION OF BETA MEASUREMENTS BY APPLICATION OF PROBABILITY THEORY. Krejsa, P.; Sorantin, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Jul 1973. 13p. INIS.

The determination of β-emitters in nuclide mixtures is generally performed by chemical separations or by the survey of the decay curves. A general method is shown to evaluate β-emitters in multi-labeled samples using liquid-scintillations techniques by the determination of the probability that a decay of a given nuclide will be registered in a given channel. By the aid of these probabilities it is possible to form equations for samples with known nuclide composition to evaluate the activities of the present nuclides. (auth)

23556 (UCID-15668) CALCULATION OF MEAN VALUES AND TREATMENT OF RANDOM ERRORS IN OUIJA. Levy, H. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jul 1970. 6p. Dep. NTIS $4.00.

In the Radiochemistry data reduction code, OUIJA, calculation of mean values for sets of data and analyses of random errors are performed by a special subroutine. The original data set, along with the precision estimates, is first put through a simple mathematical transformation. A new data variable is formed by taking the natural logarithm of the original data variable. The average value of the transformed variable is found by taking the simple unweighted arithmetic average. Two estimates of the standard deviation of this average are obtained, one from averaging the "within-pot" variances and one from the deviation of the individual values from the average. Reverse transformations yield estimates of a mean value for the original data set and two estimates of the percent standard deviation of the mean; the first estimate is based only on within-pot variances, while the second also includes any effect from pot-to-pot "fractionation." The mean value calculated in this way corresponds to a geometric mean. (auth)

23557 (UCRL-75619) CONVENIENT METHOD FOR THE DIRECT MEASUREMENT OF URANIUM IN SOIL SAMPLES USING HIGH-RESOLUTION Ge(Li) GAMMA-RAY SPECTROSCOPY. Coles, D. G.; Meadows, J. W. T.; Lindeken, C. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Jul 1974. 21p. (CONF-740701-1). Dep. NTIS $4.25.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

The direct determination of ^{238}U in various soil samples was carried out by measurement of the 63.3-keV transition from the decay of the first daughter ^{234}Th. Potential errors resulting from the chemical non-equilibrium of ^{238}U with its daughters are thus

avoided. The method sensitivity is 1 ppM compared to the 35 ppM obtainable by employing the 1001-keV gamma ray. A Ge(Li) gamma spectrometer is the only analytical tool required. Examples are offered which demonstrate the usefulness of the technique for routine inexpensive environmental monitoring of U levels. The technique also has the capability of providing information on the $^{238}U/^{235}U$ isotopic ratio. (auth)

23558 SECTIONING TECHNIQUE FOR SiO_2 AND ITS APPLICATION TO PENETRATION STUDIES. Lukac, P. (Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 18: No. 4, 203-209(21 Aug 1974).

A sectioning technique for SiO_2 was developed. This technique is based on etching of very thin layers of surface, ranging from less than $\mu g/cm^2$ of SiO_2 to more than 10 $\mu g/cm^2$. This method was used for the determination of depth distribution of implanted ^{85}Kr in SiO_2 and enabled the calculation of the range of ^{85}Kr in SiO_2. (auth)

23559 METHOD FOR PLUTONIUM DETERMINATION IN IRRADIATED NUCLEAR FUEL USING BURN-UP DATA. Schaechter, L.; Hacman, D.; Mot, O. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 1, 107-112(1974).

A method, regarding the possibility of determining the plutonium content in an irradiated nuclear fuel by using the burn-up measuring data, is being presented. (auth)

23560 SIMPLE DEVICE FOR DEKRYPTONATION THERMAL ANALYSIS. Lukac, P.; Jesenak, V.; Toelgyessy, J.; Varga, S.; Harangozo, M. (Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 18: No. 4, 239-244(21 Aug 1974).

A simple device for dekryptonation thermal analysis using a new flow-type GM-detector was designed and constructed. The device can be assembled from readily available parts. (auth)

23561 PURIFICATION OF RADIOACTIVE TRACERS FOR USE IN HIGH SENSITIVITY ALPHA SPECTROMETRY. Sill, C. W. (Atomic Energy Commission, Idaho Falls, ID). Anal. Chem.; 46: No. 11, 1426-1431(Sep 1974).

When several alpha-emitting radionuclides are determined simultaneously in a single sample by alpha spectrometry, the several tracers used to determine the chemical yields must each be relatively free of all the other radionuclides being determined to avoid increasing the uncertainty of the measurements due to the contaminants added with the tracers. Selected procedures for purification of tracers of all elements from thorium through californium are described that have been demonstrated to provide the necessary decontamination for use in high-sensitivity alpha spectrometry. Except for protactinium, all final tracer solutions can be evaporated directly on stainless steel plates to simplify standardization. (auth)

23562 DETERMINATION OF RARE-EARTH ELEMENTS BY RADIOISOTOPE X-RAY FLUORESCENCE TECHNIQUE. Saplakoglu, A.; Ozoglu, I.; Tan, M.; Erdogan, H. (Ankara Nuclear Research Center). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 2, 47-56(Jun 1974).

Concentrations of rare earth elements in ores have been determined using energy dispersive analysis by radioisotope x-ray fluorescence technique with a calculation process developed in this laboratory suitable to minicomputers. Results of experiments indicate that rare earth concentrations of about 1% can be calculated within ∓5% error with 95% confidence level. For the concentrations of 0.2%, limits of error are found to be about ∓15% and the lowest detectable limit of concentrations is estimated as 100 ppm. (auth)

23563 HIGH-VOLTAGE RADIO-IONOPHORESIS AS A TOOL FOR THE IDENTIFICATION OF NEW LONG-CHAIN SULFUR COMPOUNDS. Blasius, E.; Wagner, H. (Universitaet des Saarlandes, Saarbruecken (F. R. Germany). Inst. fuer Analytische Chemie und Radiochemie). Chem. Ztg.; 98: No. 3, 154-159(Mar 1974). (In German).

4 figs.; 5 tabs.; 64 refs.

High voltage ionophoresis with labelled compounds as an analytical method is described. It enables the composition of reaction mixtures of polythionates and seleno- and telluropolythionates or sulfanediphosphonates to be determined. For this purpose specially labelled starting compounds are reacted with one another, microlitre samples are taken at definite intervals and separated by the high voltage ionophoresis. Qualitative information is obtained from the activity distribution curves or autoradiograms. On using dual labelled compounds determination of isotope ratio provides the molecular formula. Some interesting examples are discussed after the detailed description of the method. (auth)

23564 DETERMINATION OF SMALL ACTIVITIES IN BIOLOGICAL SAMPLES AND ENVIRONMENTAL OBJECTS WITH γ-SPECTROMETER. Buyanov, N. I.; Pogudin, V. V.; Prudnikov, L. V. pp 109-115 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Coefficients were calculated taking into account that in the process of determination of radionuclides by γ spectrometry the column is incompletely filled with sample. Values of the minimal measurable specific activity of ^{137}Cs and ^{60}Co are given for some biological samples. Three types of radiation detectors were applied for this purpose. (auth)

23565 METHOD OF ^{90}Sr DISCOVERY IN BOTTOM SAMPLES. Vinogradova, V. K.; Gedeonov, L. I.; Rosyanov, S. P. pp 123-127 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

^{90}Sr discovery in bottom samples based on dissolution of Sr in 6N hydrochloric acid followed by precipitation of strontium sulfate as well as further radiochemical purification of ^{90}Sr is described. (auth)

23566 THE PRESENT STATE OF THE IMPORTANCE AND THE MEASUREMENT OF RADIOIODINE. Tschurlovits, M.; Boeck, H. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Atomkernenergie; 23: No. 3, 153-158(1974). (In German).

2 figs.; 5 tabs.; 62 refs.

Problems concerning the measurement of radioiodine are reviewed. The importance of ^{131}I and ^{129}I and the influence of different variables along the pathway on dose calculations is shown. Several measuring techniques are also presented. The properties of continuous and discontinuous methods and sampling problems are discussed. (auth)

23567 GAMMA SPECTROMETRY OF FISSION PRODUCTS: A METHOD OF NONDESTRUCTIVE BURNUP STUDIES ON REACTOR FUEL ELEMENTS. Graber, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 17: No. 6, 157-164 (Jun 1974). (In German).

Starting from the various points of view under which measurements on spent fuel elements and fuel assemblies recently were carried out, the importance of burnup studies is pointed out as a method of determining the changes in nuclear fuels arising during real operating conditions of the reactor. Experimental expenditures for, and modern possibilities of, getting information from the widely used nondestructive method of fission product γ spectrometry are discussed. In particular, performance and evaluation of the measurements on power reactor assemblies are discussed. The following problems stand to the fore with respect to further development and application: a) increase of accuracy, especially by comparing with the results of destructive methods; b) studies of correlations between the constructions of fission products and heavy nuclei. (auth)

23568 ACTIVITY DETERMINATION BY CHERENKOV RADIATION. Kits, J. (Inst. for Research, Production, and Use of Radioisotopes, Prague). Radioisotopy; 15: No. 3, 457-464(1974). (In Czech).

Activity measurements using Cherenkov radiation were carried out in aqueous solutions. The obtained results indicate that this method can be used for the activity determination of extracts. The advantages of the method are its simplicity and low costs. The setting parameters of the instrument were established and the efficiency determined for ^{22}Na, ^{32}P, ^{59}Fe, ^{60}Co, ^{65}Zn, ^{89}Sr, ^{95}Zr, ^{99}Mo, ^{106}Ru, ^{124}Sb, ^{134}Cs, ^{144}Ce, and ^{204}Tl. (auth)

Separation Procedures

Refer also to abstract 23720.

23569 (IEA-309) TECHNOLOGY OF URANIUM PURIFICATION BY SOLVENT EXTRACTION. Correction for the Uranium Loss During the Washing Stage. Franca, J. M. Jr. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Sep 1973. 15p. (In Portuguese). Dep. NTIS (US Sales Only) $4.00.

The purpose of the present work was to study the uranium loss correction on the uranium purification technology by solvent extraction, where the uranium loss is verified during continuous scrubbing. It was proved to be possible to get yield in purification, very close to 100%, against the normal 84-85% obtained through the conventional purification method, in either pulse columns or mixer-settlers. The higher yield in the process is gotten by introducing a pulse column for extraction in a small size, in between the scrubbing column and the stripping column. The new small column is fed with the outlet aqueous phase from the scrubbing column, which contains impurities. Therefore, a selective uranium extraction is done. Since the impurity rate is low (due to the decontamination held into the original extraction of about

98%), the extracted uranium from the organic phase, inside this small column has a reasonable purity index, passing through a second decontamination of 98% over the 2% of the remaining impurities from the first extraction. Afterwards, the sequence of the recovered uranium to the stripping column feed tank is described. In this tank, the recovered uranium meets the already washed uranium from the scrubbing column in the organic phase, where, finally the loss is then compensated. In a conventional process, when the uranium leaves the scrubbing column in the aqueous phase, it goes back to the beginning of the process, with a characterized off set in the process yield. The involved calculations and purity tables for the uranium in the second extraction column were also included in the work. (auth)

23570 (IEN-DQ-RC-03) EXTRACTION OF LANTHANIDES BY DIPHENYL PHOSPHINIC ACID. de Almeida, I. G. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Nov 1972. 47p. (In Portuguese). INIS.

A radiometric study was made of the partition of trivalent lanthanides between aqueous phases containing nitric acid and an organic phase consisting of a solution of diphenylphosphinic acid in chloroform. For each of the metals, the distribution ratios D were determined as a function of the inorganic acid concentration and of the temperature. The graphic presentation of log D against the atomic number of the lanthanides for given extraction conditions shows the quaternary effect, previously noted by other researchers for those elements and for the actinides. The high coefficients of distribution and of separation obtained indicate that diphenyl phosphinic acid is one of the most promising reagents for the extraction and separation of lanthanides. (INIS)

23571 (IEN-DQ-RC-05) MECHANISM FOR THE EXTRACTION OF LANTHANIDES BY DIPHENYL PHOSPHINIC ACID. de Almeida, I. G. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil). Divisao de Quimica). Dec 1972. 35p. (In Portuguese). INIS.

The distribution of trivalent lanthanides between solutions of diphenylphosphinic acid in chloroform and aqueous phase containing nitrate ions was investigated radiometrically. The distribution ratio D was studied as a function of: extractant concentration in the organic phase, mineral acid and salt concentrations in the aqueous phase, and the atomic number of the lanthanides. The distribution ratio, D, was found to vary as $[\text{extractant}]^{2.7}$ and $[H^+]^{-3}$, where the concentrations refer to the organic and aqueous phases, respectively. It therefore appears that a mixture of complex species is extracted; the possible structures of these species and a mechanism for the extraction are discussed. (INIS)

23572 (IS-3259) THERMODYNAMIC ACTIVITY MODEL FOR A SINGLE LANTHANIDE NITRATE LIQUID–LIQUID EXTRACTION SYSTEM. O'Brien, W. G.; Bautista, R. G. (Ames Lab., Iowa (USA)). 1974. 10p. (CONF-740917-2).

From international solvent extraction conference; Lyon, France (8 Sep 1974).

A thermodynamic model for a single component extraction system has been developed by making use of the thermodynamic activity of the various species, the stability constants of the inorganic complexes formed and by defining the solvent extraction equilibrium constants. Equations are given to represent the liquid-liquid extraction of a lanthanide from an acidic lanthanide nitrate solution by di(2-ethylhexyl) phosphoric acid. (LK)

23573 (NRCN-338) DYNAMIC SIMULATION OF THE EXTRACTION AND PURIFICATION TRAINS IN THE IMI PROCESS FOR PRODUCTION OF PHOSPHORIC ACID. Libhaber, M. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; Technion-Israel Inst. of Tech., Haifa). Aug 1973. 218p. (In Hebrew). INIS.

Thesis.

In the IMI process pure phosphoric acid is produced by solvent extraction from the crude acid solution. This solution is obtained by dissolving the raw phosphate rock in excess HCl. The solution contains as major components, calcium chloride, HCl, and minor quantities of impurities such as uranium. The extraction section of the process consists of four extraction batteries, but only the extraction and purification batteries are important for the uranium. To study the uranium behavior, a mathematical simulation of those two batteries was carried out. The P_2O_5 behavior was studied too, since this is the most important component. Empirical equilibrium equations were derived and results obtained are satisfactory compared to the theoretical ones. The influence of the concentration of the various other components HCl, $CaCl_2$, etc.) of the system on the behavior of uranium and P_2O_5 was studied and calculated. The results are plotted and tabulated. (INIS)

23574 (ORNL-4966, pp 54-61) CHEMICAL ENGINEERING RESEARCH. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

23575 (UCID-5052) SURVEY OF INDUSTRY PRACTICE FOR IN-SITU LEACHING OF COPPER ORES. Rabb, D. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). [nd]. 23p. Dep. NTIS $4.25.

The controlling factors of in-situ leaching are distribution of ore minerals in the matrix, degree of fragmentation, permeability packing, weathering characteristics, leach bed stability, acid consumption, swell factor, etc. Leaching copper following use of an underground nuclear explosion to fracture the ore is considered. (MCG)

23576 (UCID-15400) TEMPERATURE CONTROLLED GAS SEPARATION CELL. Owen, E. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Oct 1968. 35p. Dep. NTIS $4.75.

The design and construction of a gas separation cell and its associated temperature control system are described. The system operates over a range of −190 to more than 300°C. The facility is responsible for the separation of gas samples, obtained during nuclear tests, into their constituent components. Of particular interest are the radioactive isotopes of the rare gases. The separation is accomplished by a chromatographic method. (TFD)

23577 SORPTION OF Sc(III) AND Fe(III) IONS BY A CATION EXCHANGER FROM SOLUTIONS OF CONCENTRATED ACIDS AND ORGANIC SOLVENTS. Simek, M. (Univ., Brno). Chem. Zvesti; 28: No. 3, 343-348(1974).

The sorption of Sc(III) and Fe(III) ions by a strongly acidic cation exchanger from concentrated solutions of nitric acid and sulfuric acid in aqueous and mixed media (acetic acid and ethanol) was followed. The increased sorption of Sc(III) and Fe(III) from solutions with a high ionic strength and low permittivity is connected mainly with alterations of ionic solvation, the water activity, activity coefficients of the acids, and the increased interaction of ions in the ion-exchanger phase. (auth)

23578 RETENTION OF RARE EARTH ELEMENTS ON LANTHANUM OXALATE. Effect of Precipitate Properties on Retention Efficiency. Csajka, M. (Inst. for Physics, Budapest). Radiochem. Radioanal. Lett.; 18: No. 4, 245-250(21 Aug 1974).

It is shown that morphological changes caused by the variation of the conditions under which lanthanum oxalate precipitates are prepared affect the retention rate of rare-earth metal activities on lanthanum oxalate, and this has to be taken into account for radiochemical separations. (auth)

23579 EXTRACTION CHROMATOGRAPHY USING CHELATING AGENTS. VI. Separation of RaTh(^{228}Th) AND ITS DAUGHTER PRODUCTS ON PAPER TREATED WITH DI-(2-ETHYLHEXYL) PHOSPHORIC ACID. Sebesta, F.; Kron, I. (Technical Univ., Prague). Radiochem. Radioanal. Lett.; 18: No. 4, 217-225(21 Aug 1974).

Reversed-phase chromatography of ^{228}Th, ^{224}Ra, ^{212}Pb, and ^{212}Bi on paper treated with di-(2-ethylhexyl)phosphoric acid has been investigated, using hydrochloric acid of various concentrations as eluents. The chromatographic behavior of radionuclides studied has been correlated with their liquid-liquid distribution properties. The non-linearity of the dependence R_M vs log [HCl] has been explained by the retention of elements studied on untreated paper. On the basis of results obtained, a simple method for the separation of ^{212}Bi–^{212}Pb–^{224}Ra and ^{228}Th–^{212}Bi–^{212}Pb–^{224}Ra was developed. (auth)

23580 SORPTION AND DISTRIBUTION OF SCANDIUM, YTTRIUM, AND LANTHANUM ON THE CATIONITE KFP × 8. Kudryavskii, Yu. P.; Kazantsev, E. A.; Kazantsev, E. I. (Ural State Univ., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 7, 1097-1099(1974). (In Russian).

The separation of Sc from large quantities of Y and La was studied using the cationite KFP × 8. In 1 N HNO_3 solution the Sc was selectively adsorbed by the cationite, but the Y or La remained in the filtrate. The Sc was eluted by 0.5 to 1.0 N solutions of ammonium fluoride. (JSR)

23581 ELECTROLYSIS OF PLUTONIUM AND ITS ALLOYS. Aury, P. (CEA, Is-sur-Tille, France). pp 329-331 of Twenty-Third Meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).

From 23rd meeting of the international Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972). See CONF-720809-(Absts.).

23582 PROCESS OF RE-EXTRACTION OF SCANDIUM IN THE PRESENCE OF TITANIUM FROM BIS(2-ETHYLHEXYL)

PHOSPHORIC ACID. Koshul'ko, L. P.; Favorskaya, L. V.; Granovskii, Yu. V.; Krivenko, S. V.; Komissarova, L. N. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 7, 966-969(1974). (In Russian).

The study of the process of re-extraction of Sc and Ti by the mathematical simulation method made it possible to obtain a generalization of the mathematical model of the process. With this model it was possible to determine the optimum conditions for the extraction of Sc for any Sc : Ti ratio in the interval from 1 : 1 to 1 : 5. On the basis of the model the conditions making it possible to achieve a high degree of re-extraction of 97% Sc were found. (tr-auth)

23583 EXTRACTION OF URANIUM(VI) WITH THE DIHEXYL ESTER OF PHENYLSULFONYLAMIDO-PHOSPHORIC ACID. Shevchenko, F. D.; Malysheva, A. N.; Kuzina, L. A. (Kiev State Univ.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 7, 970-972(1974). (In Russian).

The extraction characteristics of complexes of U(VI) with the dihexyl ester of phenylsulfonylamidophosphoric acid, having the composition UO_2A_2 (where A is HEPSAP anion), were determined. The stability constants of these complexes, found by the method of graphic differentiation, are lg β_1 = 6.00 and lg β_2 = 11.32. The distribution constant of the complex is lg P_2 = 3.08 and the extraction constant is lg K_{ex} = 1.49 ± 0.03. (tr-auth)

23584 CONCENTRATION AND SEPARATION OF ELEMENTS BY MEANS OF HETEROPOLYACIDS: SORPTION AND SEPARATION OF Th AND Y. Barkovskii, V. F.; Velikanova, T. V.; Neudachina, L. K.; Yudina, L. N. (Ural State Univ., Sverdlovsk, USSR). Zh. Anal. Khim.; 29: No. 6, 1231-1234(Jun 1974). (In Russian).

Microgram amounts of thorium and yttrium ions are quantitatively sorbed on phosphoromolybdenum acid salts in the 0.05-0.5 M HNO_3 medium. Their separation is achieved by eluation of yttrium with 1 M NH_4NO_3 solution. Thorium is desorbed with 4 M HNO_3 solution. (auth)

23585 USE OF THE AB-16 ANIONITE OF EDTA-FORM IN THE CHROMATOGRAPHIC SEPARATION OF MIXTURES CONTAINING ZIRCONIUM(VI) AND TITANIUM(VI). Brouchek, F. I.; Demetrashvili, R. A. (Polytechnic Inst., Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 75: No. 1, 93-96(Jul 1974).

Processes of sorption and elution of titanium(IV) on the AB-16 and AB-17 anionites modified by EDTA anions were studied under dynamic conditions. The data obtained, in combination with previously determined regularities of the sorptive behavior of zirconium(IV), vanadium(V), iron(III), aluminium, chromium(III), nickel, cobalt, copper(II), molybdenum(VI) and tungsten(VI) on the AB-16 anionite of EDTA-form, enabled various procedures to be elaborated for chromatographic separation of these elements from mixtures containing titanium(IV) and zirconium(IV) by using the AB-16 anionite of EDTA-form. (auth)

23586 FAST SEPARATIONS ON SUPERFICIALLY SULFONATED ION EXCHANGE RESINS. Lieser, K. H. (Technische Hochschule, Darmstadt, Ger.). Radiochem. Radioanal. Lett.; 18: No. 5, 323-330(21 Sep 1974).

Superficially sulfonated ion exchange beads allow very fast separations of inorganic ions in detriment of the exchange capacity. (auth)

23587 SIMULATION OF EXTRACTION PROCESS OF SCANDIUM SEPARATION FROM IRON AND TITANIUM. Granovskii, Yu. V.; Krivenko, S. V.; Komissarova, L. N.; Kaplan, A. L.; Talipov, Sh. T. Vestn. Mosk. Univ., Ser. II. Khim.; 15: No. 3, 289-294(1974). (In Russian).

The extractive separation of a pair of elements, viz. scandium-iron in the concentration interval 2-4 N HCl and scandium-titanium in the interval from 6 to 8 N HCl by tributyl phosphate in o-xylene has been studied using the experiment factorial design technique. The mathematical models of the process were obtained on the basis of which the selection of the optimal conditions for separation depending on the adjustable factors could be fully justified. Proceeding from the results obtained on the simulation of the separation process of the element pairs the two-stage extraction of mixtures (Sc-Fe-Ti) was carried out to result in the separation of scandium from the main quantities of iron and titanium, the degree of scandium extraction into organic phase being 85.5%. (auth)

23588 INTERSEPARATION OF HAFNIUM-ZIRCONIUM FROM URANIUM MATRIX. Abdel-Rassoul, A. A.; Aly, H. F.; El-Haggan, A. (Atomic Energy Establishment, Cairo). Radiochem. Radioanal. Lett.; 18: No. 5, 267-274(21 Sep 1974).

Selective separation of Hf and Zr (80 mg) from uranium matrix (1 gm) was possible using Dowex 1 × 10-12 M HCl and 0.06 M HF system after careful investigations for different types of anion exchange resins. On the basis of batch extraction data, interseparation of Hf and Zr free from cross contamination was achieved by extraction chromatographic column of Alamine-336, using 0.5 M $(NH_4)_2SO_4$ solution at pH 0.8 as mobile phase. (auth)

23589 MECHANISM OF ION EXCHANGE IN ZIRCONIUM PHOSPHATES. XII. Calorimetric Determination of Heats of Cesium Ion-Hydrogen Ion Exchange. Clearfield, A.; Kullberg, L. H. (Ohio Univ., Athens). J. Phys. Chem.; 78: No. 18, 1812-1817(29 Aug 1974).

The heats of Cs^+-H^+ exchange on two samples of zirconium phosphate of different crystallinities were determined calorimetrically. The reactions are initially exothermic. The nearly amorphous sample attained a maximum value of $\Delta H_x^\circ = -4.5$ kcal/mole of exchanger at about 55% of exchange. At higher loadings the reaction became progressively endothermic. The high initial preference of amorphous zirconium phosphate for Cs^+ relative to other alkali metal cations stems from the greater exothermicity of the reaction. For the more crystalline exchanger $-\Delta H_x^\circ$ increased linearly up to 75% of exchange whereupon the reaction became endothermic. This indicates the formation of an exchanged phase with 1.5 mole of Cs^+ per formula weight of exchanger. The results of this study are compared to those of a similar one carried out previously for the Na^+-H^+ system. (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 23698, 23704, 24486, 24548, and 24611-24616.

23590 (IEA-305) RADIOISOTOPIC TRACER STUDY IN THE POLYMERIZATION REACTOR R811 FOR THE PRODUCTION OF POLYETHYLENE. Castagnet, A. C.; Szulak, C.; Said, M.; Ohara, T.; Nakahira, S.; Peralbo, R. A. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Aug 1973. 34p. (In Portuguese). Dep. NTIS (US Sales Only) $4.75.

The bases, methodology, and results of a radiotracer study aimed to measure the mean circulation speed of the fluid in a polymerization reactor are described. Results were obtained for the reactor working under two different conditions: (a) steady-state polymerization, and (b) circulation of solvent (hexane). Because of the reactor being a tubular closed circuit with constant cross section, the radiotracer technique known as the "two peaks" method was employed. Butane dibromine ($Br_2C_4H_8$), labeled with ^{82}Br and dissolved in hexane, was used as tracer. This radioactive compound was prepared at the DARET's laboratories, starting from elemental bromine activated in the IEA-R1 nuclear reactor. Approximately 50 cc of labeled solvent with a total ^{82}Br activity of 25 mCi incorporated at the polymerization reactor was used in each experiment. The injection was made in the solvent feeding duct, by applying a 40 ata nitrogen draught, to overcome the internal pressure of the reactor, estimated in 30 ata. The passage of the "radioactive cloud" by the measuring sections was detected with scintillation probes connected to rate-meters and portable recorders. Contrary to expectations, the radioactive solution did not become rapidly dispersed in the current of fluid that was circulating into the reactor, but remained confined for a long time in the same region where it was initially diluted. Consequently, the graph records obtained had the shape of a slightly damped periodic oscillation. This circumstance makes possible calculation and the mean speed of circulation, in cycles per second, with a standard error less than 0.5% and also establishment of the phenomenological bases of a mathematical model for describing the reactor behavior. The values of the mean speed of circulation for the two cases were as follows: (a) reactor under polymerization 0.03814 cycles/second and (b) reactor with solvent only 0.03795 cycles/second. Assuming a total length of 131,54 meters for the reactor axis, the above values are equivalent to 5.02 and 4.99 meter/second respectively. The relative difference between both results amounts to 0.5% and lies, then, within the limits of the experimental error. It can be concluded that the mean circulation speed inside the reactor is constant and equal to 0.038 cycles/second [i.e., 5 m/s, independently of the nature of the flowing fluids (solvent or solvent plus suspended polyethylene)]. Thus, the period T_0 for the circulation of fluids inside the reactor resulted 26.32 seconds. The volumetric flow rate delivered by the circulation pump, as calculated from the experimental data, was 5,000 m^3/h. The mean residence time of components homogeneously dispersed in the fluid, as well as the mean "confinement" time of products concentrated in a given region

of the flowing mass, were also determined for the particular conditions prevailing during the experiences. Supposing that under polymerization conditions the relation q/Q between the mass flow rates at the feeding and in the pump was 0.004, the mean residence and confinement times would be 6,627.7 and 3,068.6 second respectively. This shows that in the present conditions, the reactor can be extremely sensitive to local or transient variations in both the concentration and quality of the feed products. The report suggests ways to modify the response of the reactor for transient stimulus at the inlet, in order to attenuate or to eliminate possible undesirable effects on the reactor operation and/or on the quality of the finished products. Finally, the importance of completing the present study with new tests to obtain enough data for the formulation of a generalized mathematical model of the process is emphasized. (auth)

23591 KHIMIYA NESTEKHIOMETRICHESKIKH OKISLOV. (Chemistry of Non-Stoichiometric Oxides). Tret'yakov, Yu. D. Moscow; Izdatel'stvo Moskovskogo Universiteta (1974). 364p.

Many properties of oxygen-containing inorganic materials (ferrites, piezoelectric crystals, ferroelectric crystals, solid electrolytes, and bioceramics) are clearly related to their nonstoichiometric composition. The current theories on the nature of the non-stoichiometric defects in simple and complex oxides are examined. The methods and results of the study of non-stoichiometry in important systems of the metal–oxygen type are described. Special attention is given to a thermodynamic analysis of disordering processes in oxide crystals. The effect of non-stoichiometry on the kinetics and mechanisms of solid-state reactions, including sintering, and on the chemical, magnetic, electrical, and mechanical properties of the oxides and ferrites is examined. Among the oxide systems discussed are those of V, Y, Zr, Nb, Mo, the rare earths, Hf, W, Th, U, Pu, Cm, Be, and Sc. (tr-auth)

23592 FACTORS INFLUENCING THE EMF MEASUREMENT WITH SOLID ELECTROLYTE CELLS IN LIQUID METALS. Fischer, W. A.; Janke, D. (Max-Planck-Institut fuer Eisenforschung, Dusseldorf). pp 332 of Twenty-Third Meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).

From 23rd meeting of the international Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972). See CONF-720809-(Absts.).

23593 METHOD OF CHEMILUMINESCENCE USED FOR RESEARCH OF INTERACTION OF RUTHENIUM SUBMICROQUANTITIES WITH ORGANIC MATERIAL DISSOLVED IN NATURAL WATERS. Koshcheeva, I. Ya.; Varshal, G. M.; Velyukhanova, T. K. pp 116-122 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Complexing of submicro amounts of Ru(IV) with the major classes of dissolved organic substances was investigated by a kinetic method. Quantitative data on the stability of complex compounds were obtained by investigation of the inhibiting action of organic substances on Ru(IV) activity in chemiluminescent reactions of luminol oxidation by hydrogen peroxide. The stability of the Ru(IV) complexes increased in the following order: carboxylic acids, amino-oxycarboxylic acids, amino acids, fulvic acids, phenols, and polyphenols. Complexing of Ru with dissolved organic substances accounts for the high mobility of radioruthenium ($^{103}Ru + {}^{106}Ru$) in natural waters and soils as well as for the possibility of its accumulation in biological medium. (auth)

23594 DIRECT ESTIMATION OF HEXADECYLTRIMETHYLAMMONIUM-ION ADSORPTION AT LIQUID INTERFACES BY A RADIOISOTOPE TECHNIQUE. I. Specific Ion Effects at Air–Water Interface. Weiss, J.; Zografi, G.; Simonelli, A. P. (Univ. of Wisconsin, Madison). J. Pharm. Sci.; 63: No. 3, 381-388(Mar 1974).

The adsorption of the surfactant ^{14}C-hexadecyltrimethylammonium ion at the air–water interface was measured directly by detecting radioactivity emitted by adsorbed molecules. This was accomplished by placing a gas flow detector above the surface containing surfactant of known specific activity. Adsorption in the presence of potassium halide ions was found to change in the order bromide > chloride > fluoride, indicating specific ion interactions at the surface. Tetraalkylammonium halides produced the same order of effect for halide ions, but an inhibitory effect on adsorption was noted with increasing alkyl chain length. This effect appears to be related to their salting-in properties. Large hydrophobic anions, such as some alkyl- and arylsulfonates, produce two effects, depending on the concentration of surfactant and sulfonate. Ion association at the surface occurs at low sulfonate concentrations, whereas at higher sulfonate concentrations the ion association in bulk solution occurs, leading to less adsorption. (auth)

Isotope Effects

Refer also to abstracts 23663, 23675, 24403, 24444, and 24787.

23595 (IAE–2309) ISOTOPE ORDERING IN CeD_2H. Somenkov, V. A.; Entin, N. R.; Kost, M. E.; Shul'shtein, S. Sh. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 19p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The distribution of hydrogen in the octahedral and tetrahedral interstices in cerium trihydride with mixed isotopic composition CeD_2H was studied in the temperature interval from 4.2 to 300°K by the neutronographic method. It was shown that H atoms enter the octa positions of fcc lattices with greater probability (C^o_H = 0.43 at T = 300°K) than during chaotic distribution (C^o_H = 0.33). With reduced temperature C^o_H increases (C^o_H = 0.53 at T = 4.2 to 78°K). The decrease of the energy of local oscillations of hydrogen during the transition of H to the octa positions appears to be the physical cause of the redistribution of the hydrogen isotopes in the interstices of the matrix. On the basis of frequency of the local oscillations of hydrogen in CeH_3, determined experimentally from inelastic scattering of neutrons, the temperature dependence of the probability of the entrance of hydrogen into octa positions was calculated. At room temperature experimental and calculated values of the probability agree satisfactorily, but at low temperatures the experimentally measured probability C^o_H is less than the calculated probability which is most likely connected with the decrease of the mobility of the hydrogen. (tr-auth)

23596 INTRAMOLECULAR GENERAL BASE CATALYZED HYDROLYSIS AND TERTIARY AMINE NUCLEOPHILIC ATTACK VS GENERAL BASE CATALYZED HYDROLYSIS OF SUBSTITUTED PHENYL QUINOLINE-8-AND -6-CARBOXYLATES. Yurkanis, P.; Bruice, T. C. (Univ. of California, Santa Barbara). J. Amer. Chem. Soc.; 96: No. 17, 5523-5532(21 Aug 1974).

The reaction of a series of substituted (p-CH_3O, H, p-Cl, p-CN, o-NO_2, p-NO_2, and 2,4-diNO_2) phenyl quinoline-8- and -6-carboxylates (Q-8 and Q-6, respectively) with lyate species and tertiary amines was investigated (20% (v/v) acetonitrile–H_2O, μ = 0.5, 30°). The Hammett ρ values for HO^- attack on the Q-8 (ρ = 0.93) and Q-6 (ρ = 0.88) esters are of a magnitude anticipated for rate-determining nucleophilic addition to the ester group. The rate ratio $k_{HO^-}{}^{Q-8}/k_{HO^-}{}^{Q-6} \cong 0.2$ is attributed to the greater steric hindrance of the 8 isomers. Spontaneous hydrolysis (k_{H_2O}) of the Q-8 esters greatly exceeds that for the Q-6 esters and exhibits a ρ value of 0.97. Employing two alternate means of approximation, $k_{H_2O}{}^{Q-8}/k_{H_2O}{}^{Q-6} \cong 10^4$. The enhanced rate of hydrolysis of the 8 isomers is attributed to intramolecular quinoline nitrogen general base assistance to nucleophilic attack of H_2O in the case of the Q-8 esters. The reaction of tertiary amines with the Q-8 and Q-6 esters provides Hammett plots having ρ = 1.2–1.5 with the 2,4-diNO_2 substituted esters exhibiting marked positive deviations. From the similarity of the ρ values to those for HO^- and H_2O catalyzed hydrolysis, values of $k_n{}^{H_2O}/k_n{}^{D_2O}$ = 1.5–1.6 and β = 0.69 for reaction of p-NO_2-Q-6 with quinuclidine derivatives, tertiary amine catalysis of ester hydrolysis (except for the most reactive 2,4-diNO_2 substituted esters) is best ascribed to general base catalyzed attack of water. For tertiary amine catalyzed hydrolysis of the 2,4-diNO_2 substituted esters direct nucleophilic attack upon the esters is in effect: positive deviation from the $\sigma\rho$ plot indicating a change in mechanism rather than a change in the rate-limiting step, ρ > 2.0, $\kappa_n{}^{H_2O}/\kappa_n{}^{D_2O}$ = 0.8–0.9, and β = 0.95 for reaction of quinuclidines with 2,4-diNO_2-Q-6. Steric hindrance to approach of a tertiary amine to the 2,4-diNO_2 substituted esters (triethylamine and 4-morpholineethanesulfonic acid) brings about a change in the role of the tertiary amine from a nucleophilic to a general base catalyst. The rate ratios $\kappa_n{}^{Q-8}/\kappa_n{}^{Q-6}$ range from 0.6 to 0.8 for the less reactive esters. For the 2,4-diNO_2 substituted esters the rate ratios increase with decreasing amine pK_a and range from 1.4 to 79. This observation has led to the suggestion that the transition state of the 2,4-diNO_2 substituted 8 isomer is electrostatically stabilized by the quinoline nitrogen lone pair. Reaction with imidazole is characterized by a linear Hammett plot with the 2,4-diNO_2 substituted esters, unlike with other tertiary amines, evidencing no deviation. The ρ values of 2.3 and 2.4 for imidazole catalyzed hydrolysis of the Q-8 and Q-6 esters, respectively, suggest that departure of phenoxide is at least partially rate limiting. The p-CH_3O, H, p-Cl, and p-NO_2 substituted Q-6 esters are subject to imidazole catalysis of imidazole attack indicating that imidazole reacts directly with the esters as a nucleophile. This [imidazole]^2 rate term is seen only with the least reactive Q-8 ester (p-CH_3O). The decreased importance of general base catalysis and the slight increase in bimolecular rate evidenced by the Q-8 esters in their reaction with imidazole suggest that the lone pair of the quinoline nitrogen may serve to stabilize the

zwitterionic tetrahedral intermediate thereby increasing k_a sufficiently to make k_{gb} undetectable. (auth)

23597 FLUORESCENCE LIFETIMES OF INDIVIDUAL VIBRONIC LEVELS OF PARTIALLY DEUTERATED BENZENES: A FURTHER TEST OF THE THEORY OF RADIATIONLESS PROCESSES. Guttman, C.; Rice, S.A. (Department of Chemistry and The James Franck Institute, The University of Chicago, Chicago, Illinois 60637). J. Chem. Phys. 61: No. 2, 651-660 (15 July 1974).

This paper reports experimental studies of the nonradiative lifetimes of individual vibronic levels of several partially deuterated benzenes. The different deuterated species transform according to different symmetries, and therefore the number of totally symmetric modes differs from molecule to molecule. The observed rates of nonradiative decay fall into a regular pattern as a function of increasing deuteration. This observation, together with theoretical arguments, suggests that the accepting modes are, to a good approximation, local modes. Comparison of the predicted relative nonradiative rates with those observed is generally good, but not as accurate as for C_6H_6 and C_6D_6. The likely source of the discrepancy is discussed. (auth)

23598 VIBRATIONAL SPECTRA OF $H_5O_2^+$ ION IN CRYSTALLINE $YH_5O_2(C_2O_4)_2.H_2O$. Bates, J.B.; Toth, L.M. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). J. Chem. Phys. 61: No. 1, 129-137 (1 July 1974).

Polarized Raman and infrared spectra of crystalline $YH_5O_2(C_2O_4)_2.H_2O$ and its deuterated analogs were measured over the frequency interval from 20 to 4000 cm^{-1}. Primary consideration was given to recording the vibrational spectrum of the diaquated hydrogen ion, $H_5O_2^+$, and to correlating the spectral properties of this species with the results from recent neutron diffraction studies of yttrium oxalate trihydrate. Calculations based on models of $H_5O_2^+$ produced root-mean-square displacements of the central proton which were compared with the thermal parameters derived from neutron diffraction data. A comparison of calculated and observed properties suggested that $H_5O_2^+$ may be represented by a model based on a proton trapped between two water molecules. (auth)

23599 ISOTOPE EFFECTS OF ELECTROMIGRATION IN MOLTEN ALKALI NITRATES. Lunden, A.; Okada, I. (Chalmers Univ. of Tech., Goteburg). pp 343-344 of Twenty-Third Meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).

From 23rd meeting of the International Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972). See CONF-720809-(Absts.).

23600 ELECTROPHILIC ADDITION TO ORGANOXYETHENES. XII. The Features of Carboxylic Acid Addition to n-Butoxyethene. Trofimov, B. A.; Korostova, S. E.; Nedolya, N. A.; Pogodaeva, T. K.; Voronkov, M. G. (Inst. of Organic Chemistry, Irkutsk, USSR). Reakts. Sposobnost Org. Soedin., Tartu. Gos. Univ.; 10: No. 4, 965-980(Dec 1973). (In Russian).

The kinetics of non-catalytic addition of acetic, O-deuteroacetic and butanoic acids to n-butoxyethene have been studied. The reaction was carried out in the n-butoxyethene solution at 30–70°C and 0.0296 to 2.907 M acid concentration (C_0), titration of the acid with methanolic KOH in acetone, being used as a method. At $C_0 > 0.5$ M the reaction follows the pseudo-second order (the second order with respect to acid and the zero order with respect to n-butoxyethene), the rate constant (k) being calculated after Eq. (1). At $C_0 < 0.5$ M the reaction does not follow the above formalism: k increases sharply with further decreasing of C_0. From the comparison of IR spectra of acetic acid in various solvents of different concentration, it was concluded that the cause of the acceleration is the dissociation of acid to the monomeric form. However, from that it was not yet clear, why k is keeping constant during the same run, even at high acid conversion (70–80%). The "buffer effect" of the adduct (1-butoxy-1-acetoxy-ethane), which forms the H-associate with the acid, was proved to be the reason. In the presence of 1-butoxy-1-acetoxy-ethane (~1M concentration) the reaction obeys the second order, beginning already from the 0.1 M acid concentration. Though at the lower C_0 value k increases again, it is constantly left about 3 times lower than without the excess of the adduct. The kinetic isotope effect (KIE), k_R/k_D, amounts to 3.2, confirming the rate-determining proton transfer. The kinetic relationship, KIE magnitude, and activation parameters ($\Delta H^{\neq} = 16.9$ ccal/mol, $\Delta S^{\neq} = -25.0$ e.u.) are evidence for a concert mechanism in which nucleophilic attack takes place simultaneously with the electrophilic one. The polymerization of n-butoxyethene, so far not observed during the reactions of such a type, is also a feature of the addition studied, being well consistent with the proposed mechanism. (auth)

23601 CROSS SECTION AND ISOTOPE EFFECT IN THE REACTION OF F^+ WITH MOLECULAR HYDROGEN. Lin, K.; Cotter, R.J.; Koski, W.S. (Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland 21218). J. Chem. Phys. 61: No. 3, 905-910 (1 Aug 1974).

The ion–molecule reactions of $F^+(^3P)$ and $F^+(^1D)$ with molecular hydrogen and its stable isotopic variants were studied using a tandem mass spectrometer. The cross section behavior and isotope effects were similar to corresponding reactions involving Ar^+. In the higher energy regions the reaction appears to proceed by direct mechanisms. No unambiguous conclusions could be drawn about the reaction mechanism in the region below 1 eV relative energy. (auth)

23602 CALCULATED SELF- AND FOREIGN-GAS-BROADENED LINEWIDTHS FOR CH_3D. Tejwani, G.D.T.; Fox, K. (Earth Resources and Astrophysics Laboratory, Department of Physics and Astronomy, The University of Tennessee, Knoxville, Tennessee 37916). J. Chem. Phys. 61: No. 3, 759-762 (1 Aug 1974).

Self–, N_2–, O_2–, and H_2– broadened linewidths for CH_3D have been calculated using the Anderson–Tsao–Curnutte theory. Interactions due to the dipole and octopole moments of CH_3D were included. Linewidths have been computed for a wide range of angular momentum quantum numbers J and K, and temperature dependence has been obtained for $100 \leq T \leq 300°K$. (auth)

23603 ISOTOPE EFFECTS IN $CoBr_2 \cdot 6H_2O$. Legrand, J. P.; Renard, J. P. (Paris-11 Univ., 91 - Orsay (France). Inst. d'Electronique Fondamentale). pp 452-454 of Magnetic Resonance and Related Phenomena. Hovi, V. (Ed.). Amsterdam; North-Holland Publishing Company (1973).

From 17th congress AMPERE on magnetic resonance and related phenomena; Turku, Finland (21 Aug 1972).

The effect of deuteration on the magnetic properties of hydrated crystals was previously studied in some antiferromagnets. A decrease of the Neel temperature T_N of a few per cent, due to a decrease of the exchange integrals is generally observed. An NMR study of the deuteration effect in the isomorphous crystal $CoBr_2 \cdot 6H_2O$ is reported. (auth)

23604 REDUCTION PRODUCTS IN COPPER(I)-PROMOTED DIAZONIUM ION REACTIONS. Hydrogen Abstraction from Amines Coordinated to Copper(I), from Water, and from Transient Radicals. Lewin, A. H.; Peterson, N. C.; Michl, R. J. (Polytechnic Inst. of New York, Brooklyn). J. Org. Chem.; 39: No. 18, 2747-2755(6 Sep 1974).

Reduction products are observed in amine-copper(I) perchlorate promoted decomposition of aryldiazonium salts when the amine ligands are capable of hydrogen atom donation. The effective reducing agents evidently are the complexed rather than the free ligands, i.e., the tris(amine)copper(I) cation in the case of tetra- and tricoordinated salts and the bis(amine)copper(I) cation in the dicoordinated systems. In the presence of excess ligand a new product is obtained, which is probably an ammonium salt formed from the amine and the incipient aryl cation. In the absence of hydrogen-donating ligands it has been shown that the small but consistent amount of benzophenone formed in the copper(I)-promoted decomposition of 2-diazobenzophenone tetrafluoroborate arises from (a) the precursor to 9-fluorenone and (b) the solvent, water. Hydrogen atom abstraction from both these sources is rate determining and subject to a kinetic isotope effect. Since water is a notoriously poor hydrogen atom donor, transfer of a hydrogen atom from the aquated coordination sphere of copper(I) via a bridged intermediate is postulated. (auth)

23605 RECOMBINATION COEFFICIENT OF HYDROGEN ATOMS ON SILVER AND ITS CONNECTION WITH THE RATE CONSTANTS OF THE ELEMENTARY REACTIONS. Kislyuk, M. U.; Tret'yakov, I. I. (Inst. of Chemical Physics, Moscow). Kinet. Catal. (USSR)(Engl. Transl.); 14: No. 6, 1325-1330(1973).

Translated from Kinet. Katal. 14: No. 6, 1497-1504(1973).

The rate constants for the adsorption and impact recombination of hydrogen and deuterium atoms on a silver surface are measured. It is shown that adsorption proceeds without activation energy with an adhesion coefficient of ~0.05–0.1. The activation energy of recombination is 0.9 kcal/mole. Analysis of the kinetic isotope effect shows that the activated complexes of the processes in question do not possess translational degrees of freedom. The recombination coefficients of hydrogen atoms on silver are calculated from the rate constants found in a temperature range from 77 to 400°K at different concentrations of atoms in the gas phase. (auth)

23606 DEUTERIUM SOLVENT ISOTOPE EFFECTS ON THE ACIDIC HYDROLYSIS OF ALKYL HYDROGEN p-NITROPHENYL-PHOSPHONATES. Perel, J. M. New York; New York Univ. (1974). 214p. University Microfilms Order No. 74-18,193.

Thesis (Ph. D.).

Results are reported on the measurement by a previously described spectrophotometric method, of the rate constants, k_u and k_c, for uncatalyzed and acid-catalyzed hydrolysis of seven esters in H_2O and D_2O. The acid dissociation constants were calculated from the kinetics. Two kinds of isotope effects on

each kind of hydrolysis were found: (1) for isopropyl, sec-butyl and benzyl, k_c^D/k_c^H is 2.1-2.6; (2) for methyl, k_c^D/k_c^H is 0.9; (3) for isopropyl, sec-butyl and benzyl, k_u^D/k_u^H is 0.9-1.0; (4) for methyl, ethyl, neopentyl and p-nitrobenzyl, k_u^D/k_u^H is 1.20-1.38. The values of $(pK_D - pK_H)$ increase with pK_H in a linear manner with the best fit being $\Delta pK = -0.025 + 0.291\ pK_H$. The slope for the esters is much greater than the values previously suggested for plots of mixed acid types. An extensive literature survey of data obtained from the application of diagnostic criteria to acid-catalyzed reactions was evaluated in relation to deuterium solvent isotope effects. It appears that reliable selection of individual mechanisms is attainable with isotope effects data together with either entropies or volumes of activation. The usefulness of rate-acidity function relationships is limited to the determination of water participation as elaborated by Bunnett's w or ϕ concept. For most, organophosphorus compounds (including the esters presently studied) the k_{D_2O}/k_{H_2O} values of the same type of mechanism are lower than those generally found with other organic compounds. (Diss. Abstr. Int., B)

23607 ELUCIDATION OF MECHANISMS OF MULTICENTERED ORGANIC REACTIONS BY THE USE OF KINETIC ISOTOPE EFFECTS. Morrison, W. S. Jr. Ithaca, NY; Cornell Univ. (1973). 195p. University Microfilms Order No. 74-17,125.

Thesis (Ph. D.).

Dicyanoacetylene specifically enriched with ^{15}N at the cyano position was synthesized. Samples of this were allowed to react incompletely at 0°, with 0.60 to 0.90 molar equivalents of cyclopentadiene. Isotopic ratios of purified dicyanoacetylene, obtained both before and after recovery from its reaction, were measured with a modified CEC-401 mass spectrometer. This data and that already known for ^{13}C enrichment at the cyano and acetylene carbons were used to calculate heavy atom kinetic isotope effects at these three positions: 1.0013 ± 0.0002 at the cyano nitrogen, 1.0009 ± 0.0004 at the cyano carbon, and 1.0200 ± 0.0004 at the acetylenic carbon. To verify that the reaction of dicyanoacetylene with cyclopentadiene is a typical Diels-Alder reaction, activation parameters were measured and compared to values for other similar reactions. Second order reaction rates were measured by use of a specially designed low temperature dilatometer. The $\Delta H^{\ddagger}$ of the reaction was determined to be 11.5 ± 0.5 kcal $mole^{-1}$ and the $\Delta S^{\ddagger}$ to be −26.0 ± 1.6 cal $mole^{-1}$ deg^{-1}. To rule out an alternate 2 + 2 pathway followed by a rearrangement to the product, 6,7-dicyanobicyclo[3.2.0]hepta-2,6-diene was synthesized and shown to be stable under the reaction conditions. Exact computer calculations of theoretical kinetic isotope effects for this reaction were made for a number of model transition states. It was shown that it is not possible to distinguish between symmetrical or nonsymmetrical transition state structures on the basis of the magnitudes of the measured isotope effects. Some other details of the transition state could be determined. In order to fit the experimental secondary isotope effects it was necessary to use models in which the stretching force constants of the cyano groups were decreased. This apparently indicates a participation by the electrons of that group in the reaction. Exact calculations of theoretical ^{15}N and α-deuterium kinetic isotope effects were investigated for the decomposition of the following azoalkanes: azomethyl-α-phenylethane, azobis-α-phenylethane, 2,3-diazabicyclo[2.2.1]hept-2-ene, 2,3-diazabicyclo[2.2.2]oct-2-ene, and 1-pyrazoline. The results for these compounds show a surprising insensitivity of the ^{15}N kinetic isotope effect to changes in structure. (Diss. Abstr. Int., B)

23608 INFRARED BANDS OF HCNO AND DCNO. Ferretti, E. L. Columbus, OH; Ohio State Univ. (1974). 267p. University Microfilms Order No. 74-17,771.

Thesis (Ph. D.).

Results are reported for the completion of the observation, measurement, and interpretation of several vibration-rotation bands of HCNO (fulminic acid) and DCNO in the 2.7 to 20 micron region which were observed with a one-meter long absorption path. High resolution measurements of HCNO absorption spectra at 541 cm^{-1} (18.5 microns), 650 cm^{-1} (15.4 microns), 715 cm^{-1} (14.8 microns), 1250 cm^{-1} (8.0 microns), 2150 cm^{-1} (4.6 microns), 2500 cm^{-1} (4.0 microns), and 3530 cm^{-1} (2.8 microns) and DCNO bands at 2070 cm^{-1} (4.8 microns) and 2620 cm^{-1} (3.8 microns) have been analyzed. In all, thirteen bands of HCNO and three of DCNO have been positively identified, and their rotational structures interpreted. By using standard least squares procedures the molecular constants of the levels involved in the transitions have been evaluated. An energy level scheme for the vibrational levels of HCNO has been established for the first time. The assignment of the band at 541 cm^{-1} as $2\nu_5^0$ removed some of the confusion existing earlier regarding the interpretation of the stronger features observed in this spectral region. The rotational analysis of the combination band $\nu_1 + \nu_5$ was completed. Combining this information with the results from the $\nu_1 + \nu_5 - \nu_5$ band, a value of 224.101 cm^{-1} was established for the $0000\ ^0 1^1$ (ν_5) vibrational level of HCNO by employing the Ritz combination principle. The need for a similar effort for the ν_4 level is emphasized. A number of overtone and combination bands involving $\Delta v_5 = 2$ transitions were analyzed, and their interpretation is consistent with both the linear and quasilinear models which were proposed for the fulminic acid molecule. Finally, the rotational analysis of the ν_1 and ν_2 fundamentals of DCNO has enabled the determination of some of the rotational and vibrational constants for this molecule. (Diss. Abstr. Int., B)

Isotope Exchange and Isotope Separation

23609 (NRCN-326) ISOTOPIC EXCHANGE BETWEEN RADIOACTIVE IODINE AND IODOAROMATIC COMPOUNDS. Levy, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; Hebrew Univ., Jerusalem (Israel)). Aug 1973. 138p. (In Hebrew). INIS.

Thesis.

The mechanism of photochemical isotopic exchange between iodoaromatic compounds and radioactive iodine was for the first time elucidated. The exchange is carried out via reaction between phenyl radicals, obtained from excited iodobenzene molecules, and iodine molecules. Following on clarification of the exchange mechanism, it was possible to use this photochemical process for labelling organic compounds without obtaining undesirable impurities, rapidly and with very high yields. An important additional contribution of this work is to the understanding of the mechanism of the deiodination of iodoaromatics, and the chemistry of phenyl radicals in solution. (INIS)

23610 (UCID-15749) WHITNEY PROGRAM SEMIANNUAL REPORT OF THE CHEMISTRY DEPARTMENT. Part 4. Chemistry Program, January Through June 1970. Elson, R. E.; Pyper, J. W.; Snyder, E. G. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Nov 1970. 86p. Dep. NTIS $7.50.

Research progress is reported in selected summaries and abstracts of published papers. Topics covered include: plutonium metallurgy, research on dynamics and mechanical properties of materials, precipitation hardening of Mo-1 at. % Hf by internal nitriding, research on heavy elements, spontaneous fission half-life of ^{258}Fm and nuclear instability, chemical laser research, ion source for isotope separation of rare earths, isotope enrichment by electromigration, and chloride ion NMR probes. (MCG)

23611 FACILITATION OF DEUTERIUM EXCHANGE IN A SULFONE BY A γ-HALOGEN ATOM IN A RAMBERG-BAECKLUND REACTION. Bordwell, F. G.; O'Dwyer, J. B. (Northwestern Univ., Evanston, IL). J. Org. Chem.; 39: No. 17, 2519-2521(23 Aug 1974).

Observation of deuterium exchange occurring during 1,3-dehydrobromination of $Me_2CHSO_2CHBrPh$ in NaOMe-MeOD and of a low k^H/k^D isotope effect (1.2) for 1,3-dehydrobromination in 40% aqueous dioxane shows that this reaction is occurring by a two-stage, carbanion mechanism, rather than a one-stage, concerted mechanism. Deuterium exchange at the methine position of $Me_2CHSO_2CHClPh$ was found to be over 1000 times as rapid as that in the parent sulfone, $Me_2CHSO_2CH_2Ph$. It is postulated that the chlorine atom accelerates exchange not only by an inductive effect but also by facilitating solvent exchange at the initially formed singly solvated carbanion. (auth)

23612 STEREOCHEMISTRY AND MECHANISM OF THE RAMBERG-BAECKLUND REACTION. Reaction of Diastereomeric α-Halo Sulfones with Base. Bordwell, F. G.; Doomes, E. (Northwestern Univ., Evanston, IL). J. Org. Chem.; 39: No. 17, 2526-2531(23 Aug 1974).

Bromination with N-bromosuccinimide of either meso- or di-$PhCH(Me)SO_2CH(Me)Ph$ gave a nearly equimolar quantity of diastereomers, $PhCH(Me)SO_2CBr(Me)Ph$. Treatment of the higher melting erythro isomer (5a) with NaOMe in MeOH gave cis- and trans-α,α′-dimethylstilbene ina 93:7 ratio, whereas the threo isomer (5b) gave over 95% of trans-α,α′-dimethylstilbene. In reactions with 5a and 5b run to 10% or less conversion in MeOH the ratio of exchange to epimerization was ca. 50-100:1.0. The kinetics with 5a were second order, but with 5b they were independent of methoxide ion concentration when the base concentration was above 0.05 M. The latter behavior indicated that thermal decomposition of trans-2,3-dimethyl-2,3-diphenylthiirane 1,1-dioxide was rate limiting, and this was supported by independent spectroscopic evidence. Reaction of the diastereomers of $PhCH(Me)SO_2CH(Br)CH_3$ with NaOMe-MeOH was also stereoselective, one isomer (presumably threo) giving cis- and trans-2-phenyl-2-

butene in a ratio of ca. 70:30 and the other isomer (presumably erythro) giving the opposite ratio. Recovery and nmr analysis of starting materials from incomplete reactions showed that extensive epimerization was accompanying these reactions. Reaction of $PhCBr(Me)SO_2CH_2CH_3$ gave cis- and trans-2-phenyl-2-butene in a ratio of ca. 53:47, which differs appreciably from the equilibrium ratio for these alkenes (83:17). It is suggested that the stereochemistry in such instances is dictated to an appreciable extent by the formation of one of two possible diastereomeric carbanions in a higher equilibrium concentration. (auth)

23613 CONCERNING DRIVING FORCES FOR 1,3-ELIMINATION REACTIONS. Dehydrohalogenation of 1-Halo-2-thia-2,3-dihydrophenalene 2,2-Dioxides in a Ramberg–Baecklund Reaction. Bordwell, F. G.; Doomes, E. (Northwestern Univ., Evanston, IL). J. Org. Chem.; 39: No. 17, 2531-2534(23 Aug 1974).

Data obtained for the reaction of 1-bromo-2-thia-2,3-dihydrophenalene 2,2-dioxide (8) with NaOMe and MeOH, including deuterium exchange, kinetic order, kinetic salt effects, and kinetic activation parameters, are shown to be remarkably similar to data obtained under similar conditions in a study of an open-chain analog, $PhCHBrSO_2CH_2Ph$ (9). The evidence points to a two-stage (carbanion) mechanism for 8, despite the presence of a geometry that would appear to favor a one-stage (concerted) mechanism. It is concluded that the concerted mechanism for 1,3-elimination has relatively little driving force. (auth)

23614 HETEROGENEOUS EXCHANGE PROCESSES. P. 20. *AgI–^{131}I-EXCHANGE. Despotovic, R.; Stengl, V. (Institut Rudjer Boskovic, Zagreb (Yugoslavia). Dept. of Physical Chemistry).* Kolloid-Z. Z. Polym.; 250: No. 10, 950-955(Oct 1972).

7 figs.; 6 refs.

The course of the heterogeneous exchange in system $AgI–I^-$ was investigated. The radioactive tracer technique was applied by using carrier-free $^{131}I^-$. AgI was prepared as a stable sol under various final concentrations of iodide ion in the aqueous phase of 0.0001M, 0.001M and 0.01M. The quantity of the stable sol in relation to the quantity of iodide in aqueous phase was varied from α = 0.5, 1.0 to 5.0. The rate of the exchange process was higher under a higher value of α and a higher value of pI, with other parameter constant. The rate control shows that the rate of the process decreases with the aging of the sols. By increasing the temperature of the system the rate of the exchange process also increases. Electron-micrography studies show that the particles AgI increase with the increase of concentrations of the sols, with increase of the ratio α and by aging the sols. On the basis of the results obtained it can be concluded that the process of the heterogeneous exchange in system $AgI–I^-$ with stable sol generally takes place through Ostwalds ripening, while the process of autodiffusion is possible only on the smallest particles. Comparing the results obtained with the previous ones and taking into account the conditions under which the process is fastest, the system $AgI–I^-$ ($^{131}I^-$) was prepared in 0.01 M solution of uranyl nitrate. This system has shown that the exchange process is completely finished (exchange fraction F = 1) in 3,000 min. As for the radiochemical separation an important fact has been established, namely that at the beginning of the process, the lower the total iodide concentration, the faster is the process of fixation of radioiodine from the uranyl solution. The exchange rate depends on the colloid properties of the applied silver iodide suspension. (auth)

23615 QUANTITATIVE ENRICHMENT OF $^{14}CH_4$ BY MEANS OF THE CLUSIUS-DICKEL SEPARATION TUBE FOR APPLICATION IN THE ^{14}C-DATING PROCEDURE. Kretner, R. Muenchen, Ger.; Muenchen Univ. (1973). 121p. (In German).

5 figs.; 19 tabs.; 19 refs. With abstract. Available from the library of the Muenchen Univ.

An enrichment method for $^{14}CH_4$ was developed, which leads to a comparatively high enrichment factor long before the final equilibrium in the separation tube is attained. First a formula for the enrichment factor as a function of the separation factor of the separation tube as well as of the total amount of sample required and the enriched amount is developed. In the next stage a relation for the time dependence of the enrichment factor is deduced from the general theory of the Clusius-Dickel separation tube, which describes the dependence of the enrichment factor on the time, on the separation factor in the final equilibrium, and on the ratio of volume in the stock container and in the collecting container. On this basis a separation facility with a separation tube of 10.9 m length has been built for which a separation factor of 8 in the linear region of the enrichment has been assumed. In a practical test of the facility (using $^{13}CH_4$) the maximum enrichment factor reached in 16 days was 5.77. The application of artificially enriched ^{14}C-methane resulted (optimum pressure of 735 torr, total amount of methane 162 g) within 45 days in an enrichment factor of 20.6 for 1.26 g in the collecting container and of 11.4 for 4.97 g in collecting container and separation tube. This means that the assumed enrichment factor of 8 has been attained in the quasi-linear region in the collecting container after 10 days and in collecting container and separation tube after 23 days. The connection between amount of sample required, enriched amount, exploitation of sample, enrichment factor, and enrichment time is discussed on the basis of results. (GE)

23616 OPTIMIZATION OF ISOTOPE EXCHANGE COLUMNS FOR ^{15}N ENRICHMENT IN THE $NO/NO_3/HNO_3$ SYSTEM. Part I. Influence of Hydrodynamics and Aerodynamics on the Isotope Exchange. Jonas, C. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 10: No. 5, 190-198(May 1974). (In German).

The Spindel and Taylor chemical exchange procedure for the enrichment of ^{15}N was briefly outlined. Factors affecting the separation parameters were discussed and it was shown experimentally that the maldistribution of the current through the exchange column depended both on the column diameter and the column length. The distribution of the gas phase in the packed column was measured. The axial dispersion in the packed column was measured and the radial dispersion was determined as a function of the column diameter. Recommendations for optimization of the separation procedure were made on the basis of the experimental results obtained. (JSR)

23617 KINETICS OF HYDROGEN ISOTOPIC EXCHANGE BETWEEN ALCOHOLS AND AMINES IN CCl_4 SOLUTION. Bureiko, S. F.; Denisov, G. S. (Leningrad State Univ.). Reakts. Sposobnost Org. Soedin., Tartu. Gos. Univ.; 10: No. 4, 959-964 (Dec 1973). (In Russian).

The kinetics of the fast hydrogen isotopic exchange reactions between the alcohol OD group and secondary amine NH group have been measured in the CCl_4 solution by infrared absorption. The stopped-flow method with multicapillary type mixer was used; the time resolution ability (the mixing time) was 3 msec. The processes were found to be bimolecular; the rate constants and the activation energies were calculated. The data are interpreted in terms of cooperative proton transfer in cyclic intermediate hydrogen–bonded complex. The kinetic characteristics were compared with the proton-donor and proton-acceptor powers of the functional groups in the hydrogen-bonding formation. A conclusion was drawn that the exchange reaction rate was dependent on the strength of hydrogen bonds in the intermediate complex. (auth)

23618 CATALYTIC DEUTERIUM EXCHANGE REACTIONS WITH ORGANICS. LXX. The Deuteration of Alkyl Hydrogens in the Short-Chain Alkylbenzenes Using Homogeneous Platinum and Heterogeneous Platinum and Nickel Catalysts. Garnett, J. L.; Kenyon, R. S. (Univ. of New South Wales, Kensington). Aust. J. Chem.; 27: No. 5, 1023-1032(May 1974).

The mechanism of deuterium exchange in the short-chain alkylbenzenes has been studied using a homogeneous sodium tetrachloroplatinate catalyst in acetic acid solution. Carbon-14 labelled ethylbenzene has been synthesized and used to differentiate between previously proposed mechanisms. When deuteration of the side chain in ethylbenzene occurs, there is no scrambling of the α and β carbon atoms, thus eliminating the role of a symmetrically coordinated ethylene group previously proposed. This conclusion is confirmed by theoretical calculations of the exchange in ethylbenzene. The ethyl group in ethylbenzene derivatives deuterates with a low multiple character. These results from the homogeneous platinum system have been compared with corresponding data using heterogeneous platinum and nickel catalysts. Analogous intermediates are shown to be capable of existing in both homogeneous and heterogeneous systems, and are postulated to be general π-complexes for aromatic deuteration and π-allylic species for alkyl group exchange. (auth)

23619 APPARATUS FOR OBSERVING RELATIVELY RAPID HYDROGEN–DEUTERIUM EXCHANGE IN BIOPOLYMERS. Suda, N. (Tokyo Coll. of Photography); Nakanishi, M.; Tsuboi, M. Rev. Sci. Instrum.; 45: No. 5, 680-682(May 1974).

A simple apparatus is described for bringing a protein or a nucleic acid molecule abruptly from an H_2O medium into a D_2O medium and at the same time to introduce the resultant D_2O solution rapidly in a sealed cell for an infrared absorption measurement. It has a small Sephadex column and three magnet valves, and biopolymer molecules are forced to pass the column and pushed into the infrared cell with D_2O by means of an external pressure of nitrogen gas. By the use of this apparatus an infrared absorption measurement can be started at 10 sec from the "zero-time," when the biopolymer molecules are brought into contact with the D_2O molecules. (auth)

23620 CATALYTIC DEUTERIUM EXCHANGE REACTIONS WITH ORGANICS. LXXI. Homogeneous Platinum Catalyzed Deuterium of the Long-Chain Alkylbenzenes. Relationship to Alkane Exchange. Garnett, J. L.; Kenyon, R. S. (Univ. of New South Wales, Kensington). Aust. J. Chem.; 27: No. 5, 1033-1045(May 1974).

The long-chain alkylbenzenes out to nonylbenzene have been exchanged with D_2O in the presence of homogeneous platinum, deuteration occurring in both ring and side chain. ortho-Deactivation in the ring is observed, consistent with a mechanism involving a π-dissociative process. Total isotope incorporation in a particular compound decreases with increase in length and degree of branching of the side chain. In the side chain α and terminal positions deuterate predominantly, degree of isotope incorporation in these positions decreasing gradually down the series to nonylbenzene. For butylbenzene and higher homologues, deuteration of methylene positions is low. Orientation of isotope in the side chain of 1',1'-dimethylpropylbenzene is unique and is used as a basis for a novel terminal abstraction π-complex (TAPC) mechanism proposed to explain terminal exchange in the alkylbenzenes. Concepts involving "inner" and "outer" π-complexes are shown to be of value in discussing mechanisms of exchange in other positions of these compounds. The data may be related to mechanisms for simple alkane exchange using this same catalyst. (auth)

23621 ISOTOPE SEPARATION IN CHEMICAL REACTIONS OCCURRING UNDER THERMODYNAMIC NONEQUILIBRIUM CONDITIONS. Basov, N. G.; Belenov, E. M.; Gavrilina, L. K.; Isakov, V. A.; Markin, E. P.; Oraevskii, A. N.; Romanenko, V. I.; Ferapontov, N. B. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 190-191(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 336-338(20 Mar 1974).

An isotope separation method is proposed, based on the difference between the rates of chemical reactions of the isotopes under thermodynamic nonequilibrium conditions. A 20-fold enrichment with ^{15}N was obtained in the products of nitrogen oxidation in an electric discharge. (auth)

23622 DETERMINATION OF THE ISOTOPIC FRACTIONATION FACTOR OF HYDROGEN DURING THE DISSOLVING OF NATURAL METHANE IN WATER STRATA. Blaga, L.; Blaga, L. M.; Ciobotaru, T. (Inst. for Stable Isotopes, Cluj). Isotopenpraxis; 10: No. 6, 201-204(Jun 1974).

The variation of the separation factor $\alpha = C_S/C_N$ between dissolved and gaseous methane was studied by changing the pressure, temperature, and water salinity of the system. The experiments were carried out between 10 and 160 atm, 25 to 70°C, and 0 and 300 g/l water salinity. The separation factor $\alpha = C_S/C_N$ between the dissolved and undissolved methane increased with increasing pressure. The increase of the separation factor with pressure was less evident when methane was dissolved in underground water of a higher salinity. The separation factor decreased with increasing temperature and also when the salinity of the underground water increased. The value of the separation factor was 1.0005 ± 0.0001 at ambient room temperature and atmospheric pressure. (auth)

23623 KINETICS OF ISOTOPIC COPPER EXCHANGE FOR N,N'-ETHYLENE-BIS(SALICYLALDIMINATO)COPPER(II) IN CHLOROFORM. Elias, H.; Pasewaldt, R.; Voss, H.; Wannowius, K. J. (Technische Hochschule, Darmstadt, Ger.). Radiochem. Radioanal. Lett.; 18: No. 5, 341-348(21 Sep 1974).

The isotopic exchange of N,N'-ethylene-bis(salicylaldiminato) copper(II) (=Cu(salen)) with ^{64}Cu-labelled copper(II) acetate containing one mole of pyridine (=$(CuAc_2 \cdot py)$) in chloroform follows the rate law $R = k'[Cu(salen)] \cdot [(CuAc_2 \cdot py)_2]^{1/2}$. Addition of pyridine reduces the rate of exchange. A mechanistic explanation for the observed rate law and for the effect of pyridine is given. (auth)

23624 EXCHANGE REACTION BETWEEN CYCLIC ENAMINES AND DEUTEROACETONE AND ITS APPLICATIONS IN DETERMINING THE RELATIVE REACTIVITY OF CYCLIC ENAMINES. Underwood, J. G. II. Baton Rouge, LA; Louisiana State Univ. (1973). 151p. University Microfilms Order No. 74-18,376.

Thesis (Ph. D.).

Enamines undergo deuterium exchange with acetone-d_6 to produce the beta-deuterated analogue. A detailed study of the exchange reaction revealed that the rate of exchange was pseudo-first order in enamine in the presence of a ten-fold excess of acetone-d_6. The exchange process can be followed by NMR spectroscopy. The initial exchange rate for a number of enamines was determined under pseudo-first order conditions and correlated with the chemical shift of the vinylic proton as well as the reactivity in typical synthetic applications of the enamines. The enamines were grouped into three classes: cyclic and bicyclic enamines, enamines derived from heterocyclic ketones, and enamines derived from cyclic ketones. The chemical shift of the vinylic proton downfield from tetramethylsilane for the series of enamines derived from cyclic ketones increased in the order: 5/5 < 5/TM-6 < DMI/5 < 7/5 < 5/6 < m/5 < 6/5 < 7/6 < 6/6 ≈ 5/7 < 7/7. The chemical shift data correlate poorly with the relative deuterium exchange rate indicating that the electron density at the beta carbon is not the exclusive factor influencing enamine reactivity. Attempts to correlate the exchange rates with Michael addition of methyl acrylate and acrylonitrile, alkylation with benzyl and alkyl halides, acylation with propyl chloride, and the reaction with cyanogen all failed to yield a significant correlation. The poor correlations are attributed to the complicated interrelationship resulting from different mechanistic pathways of the various reactions, steric effects, competing electronic effects, and solvent effects. However, when a series of cyclic enamines prepared from a given ketone substrate was considered, the relative rate correlation studies were more successful and the deuterium exchange technique was effective in ascertaining steric contributions to relative reactivity. (Diss. Abstr. Int., B)

Feed Materials Processing

Refer also to abstracts 23748, 23966, and 24134.

23625 (Y-564) RECOVERY OF URANIUM FROM OIL SHALES. Part I. Extraction of Uranium from the Shale Gangue. Brown, K. B.; Schmitt, J. M.; Hurst, F. J.; Crouse, D. J. (Oak Ridge Y-12 Plant, Tenn. (USA)). 10 Feb 1950. Contract W-7405-eng-26. 155p. Dep. NTIS $10.75.

Declassified 29 May 1956.

A search was made for practical methods of obtaining uranium from the very low grade Tennessee (Chattanooga) oil shales. Numerous methods for extracting the uranium from the shale gangue were studied on a laboratory scale. The two most acceptable methods found involve either a direct acid leach of the crushed raw shale or a controlled roasting operation followed by a dilute acid leach. (auth)

23626 (Y-582) RECOVERY OF URANIUM FROM OIL SHALES. Part II. Recovery of Uranium from Acid Leaches of Shale. Grimes, W. R.; Blakely, J. P.; Peterson, G. R.; Andranigian, G. M. (Oak Ridge Y-12 Plant, Tenn. (USA)). 27 Mar 1950. Contract W-7405-eng-26. 101p. Dep. NTIS $8.25.

Declassified 29 May 1956.

A search for practicable methods for recovery of uranium from acid leaches of Chattanooga oil shales was made. A number of methods involving precipitation of the uranium with available inorganic chemicals were tested on a small laboratory scale. Precipitation of a major fraction of the uranium present in the leach solutions may be accomplished with any of a number of reagents; the poor selectivity of the reagents and the high ratio of extraneous ions to uranium, however, result in copious precipitates of which only a small fraction is uranium. The best of the processes studied consisted of precipitation of a uranous phosphate from solutions of low pH with or without added carrier material. (auth)

Radiation Chemistry

Refer also to abstracts 23683, 23687, 24114, 24143, 24151, 24153, 24155, 24160–24163, 24238, 24484, 24745, 24749, 24750, 24785, and 24786.

23627 (AEC-tr-7422/1) NUKLEONIKA. Translated from Nukleonika; 18: No. 1, 1-56(1973). 54p. (TT-73-54035/1). Dep. NTIS $5.75.

23628 (CALT-767P4-127) DIFFUSION KINETICS IN RADIATION CHEMISTRY: AN ASSESSMENT. Kuppermann, A. (California Inst. of Tech., Pasadena (USA). Arthur A. Noyes Lab. of Chemical Physics). 1973. 39p. (CONF-721001-3). Dep. NTIS $5.00.

From conference on physical mechanisms in radiation biology; Airlie, Virginia, USA (11 Oct 1972).

The diffusion model of the radiation chemistry of aqueous solutions is surveyed. Its ability to explain past experimental results and make predictions, over a time scale ranging from minutes down to picoseconds, is assessed. The pertinence of this model to radiation biology is discussed. (auth)

23629 (GSF-P-58) LIST OF ANALYTICAL METHODS AND INSTRUMENTS USED AT THE GSF. Schramel, P. (comp.). (Gesellschaft Fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany) Ausschuss 8 Chemische Analysen). Jan 1973. 26p. (In German). INIS.

List of the analytical and spectroscopic devices, including manufacturers' names, used in the several institutes of the GSF are given. (INIS)

23630 (IAE-2226) RADIATION POLYMERIZATION IN NEUTRAL ORGANIC PHOSPHORUS EXTRACTION SOLVENTS. Investigation Into Molecular Composition of Radiation Polymers. Kalinichenko, B. S.; Dedov, V. B.; Vladimirova, M. V.; Trukhlyaev, P. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 16p. (In Russian). INIS.

The products of radiation polymerization of tributyl phosphate and di-isoamylmethyl phosphonate were studied by gel-chromatography on Sephadex. With this method it is possible to observe the separate products or fractions of the polymer mixture, to evaluate their molecular weights, to verify whether vacuum distillation changes the composition of the polymer product, and to monitor changes due to processing with soda solutions since soda washing is the most widely used method of regenerating extractants. The proposed method of extracting the polymerization products is based on their distinction from nonirradiated extractants in relation to solvents of equal polarity. With Sephadex it is possible to observe the distribution of the polymer product between two immiscible liquids used for extraction. In gamma irradiation of individual organo-phosphorus extractants (1000 M rads), polymerization products make up more than 80% of the weight of the substance. Separation of the products of radiation polymerization by vacuum distillation of the monomers changes the composition and the average molecular weight of the polymer fraction. Washing of the polymers with soda solution removes the high-molecular acids but leaves the polymeric neutral products. The polymer fraction can be extracted by distributing the irradiated organo-phosphorus substance between two immiscible solvents (e.g., benzene and dimethylformamide). The molecular weight of the radiolysis products of tributyl phosphate and di-isoamylmethyl phosphonate was determined. (tr-INIS)

23631 (JAERI-M-5476) PROPERTIES OF TETRAFLUOROETHYLENE-PROPYLENE COPOLYMER. Okamoto, J.; Ito, M.; Matsuda, O.; Suzuki, N.; Danno, A. (Japan Atomic Energy Research Inst., Tokyo). Jan 1974. 24p. (In Japanese). NTIS (US Sales Only).

The properties of tetrafluoroethylene-propylene copolymer were studied, including molecular weight, molecular weight distribution, branches of molecule, temperature of fluid point, decomposition temperature, glass transition temperature, and thermal stability. Its molecular structure was studied with NMR and ir spectrometers. The properties as a practical elastomer, such as mechanical strength and chemical resistance were also examined. The copolymer is an amorphous and good alternative one. Its thermal properties depend on the molecular weight and monomer sequence of the copolymer. The decomposition temperature (T_d) is 360°C and the glass transition temperature (T_g) 0-10°C. The elastomer is resistant to acid, alkali, and polar solvent, but it swells somewhat in a non-polar solvent. The radiation-cured elastomer has good properties against bromotrifluoride, and its mechanical properties are better than the commercial rubbers. (auth)

23632 (JAERI-M-5495) PHYSICO-CHEMICAL CONSTANTS OF ETHYLENE, WATER AND TERT-BUTANOL, AND THEIR MIXTURES. Suwa, T.; Takehisa, M.; Tohei, M. (Japan Atomic Energy Research Inst., Tokyo). Dec 1973. 70p. (In Japanese). NTIS (US Sales Only).

The process of ethylene polymerization by radiation developed in the Takasaki Radiation Chemistry Research Establishment, JAERI, employs a mixture of tert-butanol and water as the polymerization and also the carrying medium for produced polyethylene. Physical and chemical properties of the ethylene–tert-butanol–water ternary system are important in both process design and kinetic analysis of the polymerization. However, these properties do not appear in the literature. Physical and chemical properties of ethylene, tert-butanol, and water, and the two respective mixtures are presented; where not available, they were obtained by measurement or estimation. (auth)

23633 (JAERI-M-5498) RADIOLYSIS OF CARBON DIOXIDE: EFFECT OF XENON, PROPANE, AND PROPYLENE ADDITION. Ikezoe, Y.; Sato, S.; Shimizu, S.; Kobayashi, T.; Moriyama, N. (Japan Atomic Energy Research Inst., Tokyo). Dec 1973. 10p. (In Japanese). NTIS (US Sales Only).

Radiolysis of three systems, carbon dioxide–xenon, carbon dioxide–propane, and carbon dioxide–propylene was studied in relation to the sample composition (0-100%), irradiation temperature (-196° ~ +400°C), pressure (0.05 ~ 2 atm) and dose rate (0.085 ~ 6.8×10^5 R/h). The formation of carbon monoxide was almost independent of the pressure and the dose rate. From the temperature dependence of carbon monoxide yields, the apparent activation energies were determined to be 1.7 kcal/mole (CO_2–Xe) and 0.1 kcal/mole (CO_2–C_3H_8, C_3H_6). In each of the three systems, the maximum G value of carbon monoxide was obtained with the concentration of the additives of about 1% in CO_2. The maximum G(CO) values were 0.6 and 2.9 (CO_2–Xe), 5.3 and 7.8 (CO_2–C_3H_8) and 6.0 and 6.8 (CO_2–C_3H_6) at room temperature and 400°C respectively (Except for C_3H_8 system, for which the high temperature value was obtained at 300°C). The maximum G(CO) value, which would be obtained when the back reaction of the carbon monoxide formation was hindered, and the nature of the back reaction were discussed. (auth)

23634 (JAERI-M-5501) RADIATION-INDUCED EMULSION COPOLYMERIZATION OF TETRAFLUOROETHYLENE WITH PROPYLENE: POLYMERIZATION FORMULAS AND THE CONDITIONS. Matsuda, O.; Suzuki, N.; Ito, M.; Okamoto, J. (Japan Atomic Energy Research Inst., Tokyo). Jan 1974. 27p. (In Japanese). NTIS (US Sales Only).

The radioinduced emulsion copolymerization of tetrafluoroethylene with propylene was carried out in batch operation to obtain data on the polymerization mechanism in design of the reaction process. The polymerization formulas and the reaction conditions were studied in detail. The effects of emulsifier concentration and dose rate on the polymerization rate and the degree of polymerization are discussed in comparison with the Smith-Ewart theory. The polymerization rate is proportional to the 0.26 power of the emulsifier concentration and to the 0.7 power of the dose rate. The degree of polymerization is independent of the emulsifier concentration and the dose rate above the critical micelle concentration. These results differ from the Smith-Ewart theory. The difference is presumed to be mainly due to the termination mechanism (i.e., degradative chain transfer of the propagating radical to propylene). A reaction process in a semi-flow system is proposed. It is concluded that the reaction should proceed feeding continuously a gaseous C_2F_4–C_3H_6 mixture with high tetrafluoroethylene content at a high dose rate in order to obtain the copolymer of high molecular weight at high polymerization rate. (auth)

23635 (JAERI-M-5525) RADIATION-INDUCED POLYMERIZATION OF ETHYLENE IN A BENCH-SCALE TANK REACTOR. Kawakami, W.; Hagiwara, M.; Nakajima, H.; Hosaki, Y.; Motoda, Y. (Japan Atomic Energy Research Inst., Tokyo). Jan 1974. 31p. (In Japanese). NTIS (US Sales Only).

Radioinduced polymerization of ethylene with γ rays was studied in both batch and flow system in a stirred tank-reactor to obtain the technological information for the process under various conditions of pressure 200 to 400 kg/cm^2, temperature 30 to 90°C, flow rate 300 to 3000 nl/hr, and dose rate 9×10^2 to 3.8×10^5 rad/hr with 54,000 Ci of ^{60}Co. The effect of agitation in polymerization was investigated. At 30°C, the rate and the molecular weight both decreased rapidly with increase of the agitation speed to about half the value without agitation, but then increased gradually with further increase of the agitation speed. Kinetic consideration of the results showed that the decrease is mainly due to the decrease in the propagation rate. These phenomena were not observed at 90°C. In the flow system, slip occurs between polymer and ethylene gas in the reactor, the slip ratio depends on the residence time of gas, independent of the reactor size. An empirical rate equation as a function of the residence time, slip ratio, and rate constants is also presented. (auth)

23636 (JAERI-M-5532) EFFECTS OF REACTION TEMPERATURE AND POLYMER SURFACE AREA ON THE RADIATION-INDUCED GRAFTING OF MMA ONTO RADIATION POLYMERIZED POLYETHYLENE. Sugo, T.; Wada, T.; Machi, S.; Takehisa, M. (Japan Atomic Energy Research Inst., Tokyo). Jan 1974. 14p. (In Japanese). NTIS (US Sales Only).

Radioinduced polymerization can produce powdered polyethylene of large surface area, and constant crystallinity with the surface areas variable as desired. These samples are therefore suitable for studying the effect of surface area in radiation grafting. The radiation grafting of MMA (methyl methacrylate) in gas phase by pre-irradiation in air has been investigated to observe the effect of surface area on the temperature dependence of grafting rate. In grafting at low temperature (20 to 30°C) the grafting rate depends on the rate of radical migration to the polymer surface, where the grafting takes place. The rate thus increases with surface area. At high temperatures (40 to 60°C), on the other hand, the grafting rate is determined by the radical concentration in the initial stage since the radicals decay rapidly. Temperature dependence of the grafting rate is smaller for polyethylene with large surface area. (auth)

23637 (JAERI-M-5562) RADIATION-INDUCED REACTIONS IN C_2H_6–NH_3 MIXTURE WITH ^{60}Co GAMMA-RAYS. Shimizu, S.; Ikezoe, Y.; Sato, S.; Kobayashi, T.; Moriyama, N. (Japan Atomic Energy Research Inst., Tokyo). Feb 1974. 12p. (In Japanese). NTIS (US Sales Only).

Gamma radiolysis of the gaseous mixture of ethane and ammonia was studied. Ethylamine and methylamine were obtained as the nitrogen-containing products, with the maximum G values 0.5 and 0.1, respectively. The hydrocarbon products detected were methane, propane, and n-butane. In the experiment using oxygen as the radical scavenger, it was found that the formation of ethylamine consists of ionic and radical processes. Addition of nitric oxide increases the yield of ethylamine 2.4 times in the 10% NH_3–90% C_2H_6 mixture where the maximum ethylamine yield is obtained without additives. Decomposition reaction of the ethylamine is not negligible under the experimental conditions used. (auth)

23638 (JAERI-M-5570) PRIMARY STRUCTURE AND MOLECULAR WEIGHT DISTRIBUTION OF RADIATION-POLYMERIZED POLYETHYLENE "TAKATHENE". Yamaguchi, K.; Machi, S.; Takehisa, M. (Japan Atomic Energy Research Inst., Tokyo). Feb 1974. 27p. (In Japanese). NTIS (US Sales Only).

The primary structure and molecular weight distribution of radiation-polymerized polyethylene (Takathene) were studied on the basis of solution properties. The correlation between number average molecular weight of polymer and intrinsic viscosity of tetralin solution at 130°C differs for the fractionated and the unfractionated samples. No large difference in the correlation, however, is observed between the polymer produced by gas-phase polymerization and that produced in tert-butyl alcohol. The number of long-chain branchings per molecule is estimated from g-factor to be 2 to 5, regardless of the method of polymerization. The long-chain branching is also confirmed by GPC. The molecular-weight distribution varies from unimodal to bimodal shape, depending on the polymerization conditions. The observed distribution curve from GPC deviates from the calculated one, possibly due to the reaction of chain transfer to dead polymer. The effects of reaction conditions on the molecular weight distribution in Takathene-PICW are similar to those in the small-scale batch experiment. (auth)

23639 (JAERI-M-5591) RADIATION-INDUCED POLYMERIZATION OF ETHYLENE WITH THE PILOT PLANT PCW. II. Kurihara, H.; Nakajima, H.; Watanabe, H.; Hashiba, H. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 115p. (In Japanese). NTIS (US Sales Only).

Research and development were carried out for two years from August 1967 on the radiation polymerization of ethylene in aqueous solutions of tert-butyl alcohol, with the pilot plant PCW using an external source wet-wall type reactor of 10-liter capacity. The purpose was to establish the method of continuous removal of polymer from the reactor and prevention of the polymer from deposition onto the reactor wall. Continuous removal of the polymer could be achieved by flowing the polymer as a slurry in tert-butyl alcohol aqueous solution. Prevention of polymer deposition onto the reactor wall was tried by various methods and circulating a heavy-phase liquid along the wall was finally proved to be effective. Experiments were carried out quantitatively under the pressures of 100 to 400 kg/cm^2 and the temperatures of 30°C to 80°C, to observe the effects of reaction conditions. The state of polymer deposition was also studied. (auth)

23640 (JAERI-M-5592) PROPERTIES OF POLYETHYLENE PRODUCED BY RADIATION POLYMERIZATION OF ETHYLENE IN GAS PHASE. Machi, S.; Yamaguchi, K.; Sugo, T.; Shioji, Y.; Toyota, N. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 65p. (In Japanese). NTIS (US Sales Only).

The structure and properties of polyethylene obtained by radiation polymerization of ethylene in gas phase with a bench-scale apparatus and a pilot plant were studied. The effects of reaction conditions on the physical properties were observed, such as pressure, temperature, and ethylene flow-rate on the molecular weight, content of the methyl branching, melt flow index, and density of the polymer. The molecular-weight distribution measured was found to be in good agreement with the theoretical one. The effects of molecular weight and degree of chain branching on the bulk crystallization in solid and from the melt were also studied. The relation was observed between morphology of the single crystal formed from the dilute solution of polymer and its molecular weight. The mechanical properties measured, including stress cracking, creep strength and elongation are discussed on the basis of polymer structure. (auth)

23641 (JAERI-M-5600) SAFETY OF THE PILOT PLANT PICW FOR RADIATION-INDUCED POLYMERIZATION OF ETHYLENE. Watanabe, H.; Takehisa, M.; Tohei, M.; Shimada, T. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 50p. (In Japanese). NTIS (US Sales Only).

A compilation is presented of the documents in application for use of radioisotopes, which were submitted to Radiation Safety Section, the Atomic Energy Bureau, on construction and operation of the pilot plant PICW (pilot plant for radioinduced polymerization of ethylene with a 50-liter, center-source, wet-wall reactor), a modification of the pilot plant PCW. The modification of the pilot plant is described and calculations of the structural strengths of its main components according to the design code of high-pressure plants, capability of the safety devices, and radiation safety including the mechanical strength of a radiation source are discussed. Safety of the pilot plant, which involves the simultaneous occurrence of radiation and inflammable ethylene was confirmed by case studies of improbable accidents, which are guarded against by multi-step safety means. (auth)

23642 (JAERI-M-5601) POLYMERIZATION OF TETRAOXANE IN THE PRESENCE OF MOLECULAR HALOGEN OR HYDROCARBON HALIDE. Nakase, Y.; Yoshida, M.; Sakamoto, M.; Ito, A. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 40p. (In Japanese). NTIS (US Sales Only).

In the course of studies with regard to the effect of solvents on the rate of radioinduced polymerization of tetraoxane, it was found that a hydrocarbon halide could initiate the polymerization of tetraoxane. High-molecular-weight polyoxymethylene is obtained with hydrocarbon iodide or iodine as initiator. The initiators are useful for obtaining thermally stable polyoxymethylene without additional stabilization process. The polymerization rate can be significantly increased by the combined use of halogen or hydrocarbon halide and ionizing radiation due to the synergistic effect. Only 1 to 10 ppM of halogen or hydrocarbon halide, based on the amount of tetraoxane, can initiate the polymerization of tetraoxane at a sufficient rate. Synergistic effect on the polymerization rate is also observed when a mixture of halogen and hydrocarbon halide is used as the initiator. (auth)

23643 (KURRI-TR-105, pp 6-10) STUDY ON THE SOLVATED ELECTRON BY EXTREME LOW TEMPERATURE TECHNIQUES. Hase, H. (Kyoto Univ.). 1972. (In Japanese).

Studies on the trapping mechanism and the structure of the trapped electron formed in the organic glass by irradiation of γ rays at 4°K by means of ESR and light absorption techniques are summarized. In all solvents the spectral peaks obtained by γ-irradiation at 4°K were shifted to the lower energy side compared to that obtained by 77°K irradiation, and shifted to the higher energy side in the warming-up process agreeing at 77°K with that obtained by 77°K irradiation. According to the absorption spectra the solvents are divided in to two groups. In the first group the spectra obtained by 4°K irradiation are similar to those obtained by 77°K irradiation. Methanol, MTHF, and 10M caustic soda (λ max = 650 nm, half-width = 1.5 eV) belong to this group. The spectra of the second group have new bands in the infrared region which are not observed in the spectra of 77°K irradiation and vanish in the process of increasing temperature, as well as visible bands: ethylene glycol/water (an infrared band starting from 1200 nm and a visible band of λ max = 714 nm) and ethanol (an infrared band of λ max = 1500 nm which can be photobleached by irradiation of 1700 nm monochromatic light). In the solvent of the first group the permanent dipoles of matrix molecules orient around the trapped electron at both 4°K and 77°K, but in the second group this orientation is either not or hardly occurring. The peak width of the ESR spectrum of the trapped electron in ethanol of 4°K irradiation was 6.5 G and different from that (15 G) of 77°K irradiation. By infrared light irradiation this sharp component disappeared leaving a line with a width of 13.5 G. (JA)

23644 (KURRI-TR-105, pp 11-14) STUDIES ON CATION SPECIES BY PULSED ELECTRON IRRADIATION. Imamura, M. (Inst. of Physical and Chemical Research, Saitama, Japan). 1972. (In Japanese).

In various solvents, t-stilbene was dissolved and the solution then irradiated with pulsed electron beam with 0.5 μ sec width accelerated in a Van de Graaf accelerator of 3 MeV. The solvents were classified according to t-stilbene ion formation. In benzonitrile, only cations were formed, whereas in cyclohexane, dimethyl formamide, and acetonitrile, only anions were formed. In benzonitrile saturated with air, dimer cations were formed. In dimethylsulfoxide and benzene, both cations and anions were formed. For the study of ions formed in solvents by irradiation, the t-stilbene is especially suited because absorption spectra of anions and cations are observed separately from each other and because these spectra appear in wavelength regions, which are convenient for measurement. The spectra also show little superposition with those of other intermediates such as activated molecules and radicals. Several absorption peaks in the spectra disappear when air is saturated in solvents. This disappearance gives a key for the elucidation of irradiation mechanism. Saturation with N_2O also gives interesting results. The equilibrium constant of the reaction, $S^+ + nS \rightleftarrows S^+_{n+1}$, where S is a chemical species, was ca. 10 for the t-stilbene at 25°C, ca. 30 for anthracene at 16°C, $(5.2 \pm 1.5) \times 10$ for 1,2-benzanthracene at 20°C, and $(5.2 \pm 1.5) \times 10^2$ for naphthalene at 17°C. Not only dimer cations but also polymer cations are formed in some solvents. (JA)

23645 (KURRI-TR-105, pp 15-18) INTERMOLECULAR AND INTRA-MOLECULAR SHIFTING OF POSITIVE HOLE IN LIVING BODIES. Kominami, S. (Kyoto Univ.). 1972. (In Japanese).

Single crystals of L-cystine-2 hydrochloride, DL-methionine, and N-acetyl-DL-methionine were irradiated with gamma rays or x rays in the dark or at 77°K, and radical ions produced in these single-crystals were observed by ESR method. At the same time, light absorption of the single crystal was measured and radical change by light illumination was studied in order to observe a condition of damaged molecules more minutely. In the case of L-cystine-2 hydrochloride, it was suggested that intramolecular shifting of positive hole was induced by visible light because reaction coefficients in reduction of light absorption spectrum of $-S^{-}-S-$ and $-S^{+}-S-$ were the same and wave length reliance of reduction showed its peak at 550 nm. Radical ion produced in DL-methionine was identified as radical ion of $R-S^{+}-CH_3$ and it was thought that radical ion was decreased by recoupling of electron with positive hole induced by intramolecular shifting of positive hole as well as the case of L-cystine 2 hydrochloride. In the case of N-acetyl-DL-methionine, radical ion was identified as that by $R-S^{+}-CH_3$ because its analytical value was very similar with that of methionine. In either case, it was shown that light absorption was based on shifting among sulfur non-bonding orbit and that between δ_c-S bonding orbit and δ_c-S non-bonding orbit when Pryee method was used. (JA)

23646 (LFEN-NI.-80(a)) PLASTIFICATION OF WOOD BY GAMMA IRRADIATION. Alves, F. F.; Barbosa, M. R.; Coimbra, M. R. (Junta de Energia Nuclear, Sacavem (Portugal). Lab. de Fisica e Engenharia Nucleares). 1973. 47p. (In Portuguese). Dep. NTIS (US Sales Only) $5.50.

The modification of the physical properties of woods of poplar, pine, and eucalyptus by impregnating them with a moner followed by γ polymerization was studied. The monomers and polymers used were styrene-acrylonitrile + carbon tetrachloride, styrene-acrylonitrile + methanol, polyester resin, and polyester resin + styrene. The quantity of monomer impregnated was determined as a function of time and the amount evaporated during the irradiation was measured. The polymerization yield was determined and the effect of a pre-irradiation of the wood and the method of residual monomer extraction on the polymerization yield were determined. The dimensional alterations caused by plastification were examined. The distribution of the polymer in the treated samples was determined. The surface hardness, resistance to compression, water absorption and dimensional stability, and resistance to corrosion of the treated wood were established. (JSR)

23647 (NYO-2807-67) DIFFUSION EFFECTS IN BATCH REACTORS. Mahoney, J. A.; Axtmann, R. C. (Princeton Univ., N. J. (USA). Dept. of Chemical Engineering). [nd]. Contract AT(30-1)-2807. 22p. (CONF-700512-2). Dep. NTIS $4.25.

From symposium on photochemical reactors; San Juan, Puerto Rico (May 1970).

Gas phase chain reactions were investigated for radiolytic and photochemical batch reactors. The steady state treatment leads to a nonlinear equation of continuity when there is competition between volume termination and wall termination of the chain carriers. The equation is solved analytically for several limiting cases and numerically for a range of experimental conditions. For many situations of experimental interest, and particularly ones that involve short chains, the numerical solution indicates that the reaction yield may be remarkably insensitive to either pressure or dose rate. In such circumstances the existence of a chain reaction might easily be masked as is demonstrated by an analysis of experiments on isotopic exchange in nitrogen gas. (auth)

23648 (SGAE-2291) RADIOLYSIS OF BINARY AROMATIC MIXTURES ^{14}C-LABELED IN ONE OF THEIR COMPONENTS. Proksch, E.; Mayer, F.; Krenmayr, P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Forschungszentrum). Jun 1974. 10p. Dep. NTIS (US Sales Only) $4.00.

Anthracene-phenanthrene and naphthalene-2-methylnaphthalene mixtures were irradiated with fast neutrons to a dose of 3500 Mrad. Carbon-14 labeling of anthracene and naphthalene was used to study the decomposition mechanism. Results show that the decomposition is predominantly by a radical mechanism. (LK)

23649 GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC INVESTIGATIONS OF IRRADIATED OR HEATED FATS, OILS, AND MODEL-SUBSTANCES. P. 1. Hydrocarbons from Tripalmitate, Tristearate, and Trioleate. Drawert, F.; Beck, B. (Technische Univ. Muenchen, Weihenstephan (F. R. Germany). Inst. fuer Chemisch-Technische Analyse und Chemische Lebensmitteltechnologie). Z. Lebensm.-Untersuch. Forsch.; 155: No. 1, 1-9(Jun 1974). (In German).

3 figs.; 3 tabs.; 5 refs. Part of the thesis by Beck, B.

During irradiation with 6 Mrad or heating at 170°C for 24 h, unsaturated and saturated hydrocarbons are formed out of tripalmitate, tristearate, and trioleate; by heating, cyclohexenes are also formed. The splitting products found are analyzed and discussed. (auth)

23650 ISOTOPIC COMPOSITION OF RADIOLYTIC HYDROGEN FROM IMPURIFIED H_2O-D_2O MIXTURES. Znamirovschi, V.; Mastan, L; Cozar, O. (Univ. of Cluj). Radiochem. Radioanal. Lett.; 18: No. 4, 227-231(21 Aug 1974).

Effect of solutes on isotopic composition of radiolytic hydrogen in terms of the deuterium concentration in H_2O-D_2O mixtures was studied. (auth)

23651 CONTRIBUTION TO THE RADIATION PREPARATION OF WOOD-PLASTIC MATERIALS. IV. Radiation-Induced Copolymerization of Styrene and Methyl Methacrylate or Styrene and Chloroprene in Preparation of Wood-Plastic Combinations. Varga, S.; Platrik, M. (Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 18: No. 4, 191-196(21 Aug 1974).

The conditions for the preparation of WPC from monomer mixtures of styrene-methylmethacrylate (S-MMA) and styrene-chloroprene (S-CH) were studied. The influence of the mixture composition, CCl_4, and dibenzoylperoxide on the process of radiation polymerization were also studied. The dependence of the conversion for the mentioned compound incorporated in wood on the radiation absorbed doses was obtained. (auth)

23652 LIGHT INTENSITY DEPENDENCE OF PHOTOCURRENTS AND BLEACHING RATES FOR TRAPPED ELECTRONS IN γ-IRRADIATED ORGANIC GLASSES. Dismukes, G.C.; Hager, S.L.; Morine, G.H.; Willard, J.E. (Department of Chemistry, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 61: No. 1, 426-427 (1 July 1974).

The light intensity dependence of photobleaching and photoconductivity has been measured in γ-irradiated glasses of 3-methylpentane, 3-methylhexane, and 2-methyltetrahydrofuran. (AIP)

23653 ELDOR ENHANCEMENT ARISING FROM ADMIXTURE OF NUCLEAR SPIN STATES. Iwasaki, M.; Toriyama, K.; Nunome, K. (Government Industrial Research Institute, Nagoya, Hirate, Kita, Nagoya, Japan). J. Chem. Phys. 61: No. 1, 106-114 (1 July 1974).

ELDOR enhancement effects arising from the admixture of nuclear spin states have been studied with the irradiated single crystals of potassium hydrogen maleate, which give strong forbidden ESR lines. When the magnetic field was applied along the c axis, all of the ELDOR transitions involving no level in common showed enhancement while those involving a level in common showed reduction. In the different orientations of the crystal, some of the enhanced lines changed into reduced ones with decreasing forbidden ESR transition probabilities. The temperature changes of the ELDOR spectra were also studied. With decreasing temperature, all of the enhanced lines at room temperature changed into reduced lines giving maximum R factors at around -100°C. These results were interpreted in terms of large intramolecular cross relaxation probabilities that are due to the admixture of the nuclear spin states in our system. To calculate the R factors for our system, the generalized expression has been derived for the R factor in multiobserving and multipumping ELDOR experiments. The variation of the observed R factors with pumping transitions is qualitatively understood from the R factors calculated with appropriate assumptions on the relaxation probabilities. The calculated R factors also show that increasing nuclear spin relaxation probabilities with decreasing temperature are responsible for the temperature change of the observed R factors. (auth)

23654 ENDOR STUDY OF x-IRRADIATED GLYCYLGLYCINE HCl. Lee, J.Y.; Box, H.C. (Physics Department, State University of New York at Buffalo, Buffalo, New York 14214). J. Chem. Phys. 61: No. 1, 428-428 (1 July 1974).

The primary products formed by ionizing radiation in single crystals of glycylglycine hydrochloride x-irradiated at 4.2°K have been studied by ENDOR spectroscopy. (AIP)

23655 THERMOLUMINESCENCE RECORDER FOR ORGANIC SUBSTANCES. Nikol'skii, V. G.; Mironov, N. A. (Inst. of Chemical Physics, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 10, 1655-1667(Oct 1973).

Translated from Zavod. Lab.; 39: No. 10, 1272-1274(Oct 1973).

The present device type TLG-69m was designed to observe and record structural transitions in organic substances by means of radiothermoluminescence. The method involves observing emission from heated specimens that have been irradiated at low temperatures by fast electrons or by gamma rays. (LK)

23656 EFFECT OF GAMMA RAYS ON STARCH EXTRACTED FROM IRRADIATED WHEAT FLOUR. Abd Allah, M. A.; Foda, Y. H.; El Saadany, R. (Ain Shams Univ., Cairo (Egypt). Dept. of Food Science). Staerke; 26: No. 3, 89-93(Mar 1974).

1 fig.; 3 tabs.; 31 refs.

Irradiated starch was more retrograded than the unirradiated samples. The amylose fractions increased at the expense of the amylopectin fractions of starch under the influence of gamma rays. Oxidation of starch with periodate ions was enhanced by gamma irradiation as indicated by the formation of greater amounts of formic acid in the irradiated samples. Results indicated that destruction had occured in amylopectin and small branched fragments had formed. The decrease in intrinsic viscosity due to radiation showed a straight line relation, when plotted versus radiation doses, with a slope of 5.2×10^{-7}. This indicates that a specific slope could be obtained, which characterized gamma ray doses on wheat flour. (auth)

23657 PHOTOCHEMICAL AND γ-RAY-INDUCED REACTIONS OF NUCLEIC ACID CONSTITUENTS. Suppression of the Reactivity of Pyrimidines in the Presence of Purines. Leonov, D.; Elad, D. (Weizmann Inst. of Science, Rehovot, Israel). J. Amer. Chem. Soc.; 96: No. 17, 5635-5637(21 Aug 1974).

It has been reported that some photochemical reactions of nucleic acid bases in partially aqueous solutions are selective for purines. The decrease in the reactivity of the pyrimidines is due to the presence of the purines, which also affect the extent of the photodimerization of pyrimidine bases. In mixing equal amounts of pyrimidines with purines, the formation of the photoproduct was completely inhibited for DMU, DMT, and uridine and suppressed to a considerable extent for uracil. The effect of the presence of purines on the reactivity of pyrimidines in the acetone-photosensitized dimerization of pyrimidine bases was examined. In the use of tert-butyl alcohol, 2-propanol, on DMSO as solvents, the addition of caffeine or adenosine to the reaction mixture led to a suppression of the chemical reactivity of the pyrimidines. It is assumed that base association (stacking) is responsible for this effect. (JSR)

23658 ENDOR STUDIES OF THE SUPERHYPERFINE COUPLINGS OF HYDROGEN BONDED PROTONS. II. PROTONATED RADICAL ANION IN IRRADIATED SUCCINIC ACID SINGLE CRYSTALS. Muto, H.; Nunome, K.; Iwasaki, M. (Government Industrial Research Institute, Nagoya, Hirate, Kita, Nagoya, Japan). J. Chem. Phys. 61: No. 3, 1075-1077 (1 Aug 1974).

The carboxyl radical anion trapped at 77°K in an irradiated single crystal of succinic acid has been studied by ENDOR in order to determine if the anion is protonated. The ENDOR spectra showed that the anion exhibited hyperfine couplings to the two OH protons. The principal values of the two coupling tensors are nearly the same and the principal directions are accounted for by the structure of R-C$(OH)_2$, that is, the protonated form of the anion. The location of the extra proton suggests that the proton is transferred from the neighboring molecule across the hydrogen bridge. (auth)

23659 MONTE CARLO SIMULATION OF RADIATION-INDUCED GRAFTING REACTIONS. II. The Effects of Fluctuation and Dispersion in Growth Rates on the Grafting of Styrene onto Cellulose Acetate. Yasukawa, T.; Sasaki, Y.; Murakami, K. (Tohoku Univ., Sendai). Tohoku Daigaku Hisuiyoeki Kagaku Kenkyusho Hokoku; 23: No. 1, 33-41(Jul 1973). (In Japanese).

Grafting reactions of styrene onto pre-irradiated cellulose acetate films at 50°C were simulated with several models on the basis of kinetic data obtained by the Br-labeling method. The effects of the chain length dependence of coupling probability of graft radicals and the fluctuation and dispersion in growth rate of graft radicals were investigated in detail. The comparison of the molecular weight distributions obtained by simulations with the observed distribution showed that the coupling probability of polystyryl radicals is proportional approximately to the inverse square root of chain length and that the growth rate of graft radicals is dispersed to some extent. This irradiation was done using ^{60}CO γ-rays at a dose rate of 2×10^5 rad/hr and a total dose of 4×10^6 rad. (auth)

23660 ESR STUDY OF TRAPPED ELECTRONS PRODUCED IN ALKANE GLASSES AT 4°K. Hase, H.; Warashina, T.; Ogasawara, M.; Higashimura, T. (Research Reactor Institute, Kyoto University, Kumatori-cho, Senna-gun, Osaka, Japan). J. Chem. Phys. 61: No. 3, 843-847 (1 Aug 1974).

In gamma irradiated 3-MP, MCH, and 3-MHX glasses, the same e^-_t yields were obtained between 4 and 71°K, indicating that electrons are stabilized in pre-existing traps prior to solvation. The linewidths were reduced on warm-up of the glasses irradiated at 4°K and depended on the annealing time at 71°K, implying that the solvation occurs very slowly around 71°K. A comparative study of power saturation in 3-MP and MCH suggested that the spurs formed at 4°K were spatially expanded compared to those at 71°K. The structural change of trapping sites caused by solvation was clearly reflected on the power saturation characteristics. (auth)

23661 EFFECT OF AN EXTERNAL ELECTRIC FIELD ON THE YIELD OF FREE IONS. III. ELECTRON SCAVENGING AT SMALL CONCENTRATIONS. Mozumder, A. (Department of Chemistry and the Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). J. Chem. Phys. 61: No. 3, 780-785 (1 Aug 1974).

The method of prescribed diffusion has been applied to obtain the evolution of the neutralization process of an ion pair in the presence of an external electric field. For relatively small external fields the probability of escape calculated by this method agrees exactly with the Onsager formula. The probability of the existence of the ion pair against neutralization has been evaluated in the long-time limit and its Laplace transform determined to give the scavenging probability in the presence of an external field E at small concentrations. Analysis of the results shows that, at small concentrations, the yield of the scavenging reaction should vary with scavenger concentration c as $(c+c_0E^2)^{1/2}$, where c_0 is some constant, rather than simply as $c^{1/2}$. Replotting of the experimental data of Rzad and Bakale according to the present procedure removes the discrepancy between their extrapolated yield at zero concentration and the results of the Onsager theory. The maximum and minimum scavenger concentrations within which a square root variation of yield with concentration is to be expected are evaluated as functions of the external field. (auth)

23662 FORMATION OF Cd^+ IONS IN γ IRRADIATED CADMIUM(II) CARBOXYLATES. Both, R.J.; Herring, F.G. (Department of Chemistry, University of British Columbia, Vancouver, British Columbia, Canada, V6T 1W5). J. Chem. Phys. 61: No. 3, 1249-1249 (1 Aug 1974).

Various cadmium(II) carboxylate salts were irradiated with γ rays at 77°K. The formation of cadmium(I) by electron trapping was studied using ESR spectroscopy. (AIP)

23663 ELECTRON SPIN RESONANCE OF $Co(CN)_5^{3-}$ IN x-IRRADIATED SINGLE CRYSTALS OF $K_3Co(^{12}CN)_6$ AND $K_3Co(^{13}CN)_6$. Booth, R.J.; Lin, W.C. (Department of Chemistry, University of British Columbia, Vancouver, British Columbia, Canada). J. Chem. Phys. 61: No. 3, 1226-1229 (1 Aug 1974).

An ESR study of x-irradiated single crystals of $K_3Co(^{12}CN)_6$ showed that any of the three perpendicular bonds of $Co(CN)_6^{3-}$ may be cleaved in the formation of the $Co(CN)_5^{3-}$ ion. The delocalization of spin was studied through the ^{13}C splittings in x-irradiated single crystals of $K_3Co(^{13}CN)_6$. The spin density distribution was calculated to be Co($3d_z$ 2) 0.79, Co(4s) 0.05, C(2s) 0.032, C(2p) 0.068. (auth)

23664 ENDOR STUDY OF LONG-RANGE SPIN INTERACTIONS IN MOLECULAR CRYSTALS. I. 1-METHYL URACIL. Herak, J.N.; McDowell, C.A. (Department of Chemistry, University of British Columbia, Vancouver, British Columbia, Canada V6T 1W5). J. Chem. Phys. 61: No. 3, 1129-1135 (1 Aug 1974).

ENDOR spectroscopy has been used for the precise measurements of the proton couplings in two different radicals derived from 1-methyl uracil by gamma ray irradiation. Couplings of the protons located in as many as 7 molecules in the host crystal around the free radical have been identified. The intermolecular spin interaction is predominantly of dipolar character. For the remote protons it is well described by the point-dipole approximation. Intramolecular proton couplings are more complex because of the significant isotropic component and delocalization of the unpaired electron. (auth)

23665 ESR STUDY OF FREE RADICALS IN IRRADIATED SINGLE CRYSTALS OF POTASSIUM HYDROXYLAMINE DISULFONATE. Holmberg, R.W. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Wilson, B.J. J. Chem. Phys. 61: No. 3, 921-925 (1 Aug 1974).

Two free radicals formed when single crystals of potassium hydroxylamine disulfonate are irradiated with gamma rays at 77°K were studied by ESR. The ESR spectra result from a predominant center (radical A) exhibiting large ^{14}N and ^{1}H hyperfine splittings and from lesser amounts of Fremy's radical [$ON(SO_3)_2^{2-}$]. The g and hyperfine tensors of these radicals have been evaluated and are discussed. Radical A, whose identity remains in doubt, may be regarded as the precursor to Fremy's radical; on warming its lines decay and those of Fremy's radical are formed. Lines from radical A decrease in strength and those of the hydroxyl radical (OH) grow in strength when irradiated crystals are photolyzed at 77°K. The reverse reaction occurs in the dark; the hydroxyl radical disappears and radical A is reformed. (auth)

23666 ENDOR CHARACTERIZATION OF THE FREE RADICAL IN IRRADIATED THYMIDINE. Box, H.C.; Budzinski, E.E.; Potter, W.R. (Department of Biophysics, Roswell Park Memorial Institute, Buffalo, New York 14203). J. Chem. Phys. 61: No. 3, 1136-1139 (1 Aug 1974).

The stable free radical produced by ionizing radiation in the nucleoside thymidine has been studied by ENDOR spectroscopy. The radical is formed by addition of hydrogen to the C_6 carbon atom of the thymine ring. The hyperfine couplings of the CH_2 protons and the methyl group rotational splitting constant are deduced from ENDOR measurements at 4.2°K. (auth)

23667 PULSE-RADIOLYSIS OF BINARY LIQUID ALCOHOL SYSTEMS CONTAINING BENZENE. Brown, B. J. (Univ. of New South Wales, Kensington); Barker, N. T.; Sangster, D. F. Aust. J. Chem.; 27: No. 5, 1129-1132(May 1974).

The effect of added benzene on the yield and decay rate of the solvated electron in liquid methanol, ethanol, and propan-1-ol has been investigated by pulse-radiolysis. The optical transition energy of e_s^- is independent of mixture composition, but the decay rate increases and the $G(e_s^-)$ value decreases with increasing benzene concentration. The nature of the electron trap and the mechanism of electron solvation in the alcohols is apparently unaltered by the presence of aromatic hydrocarbon. The results are interpreted in terms of electron reactions with the scavenger before, and after, solvation. (auth)

23668 REACTION OF ION RADICALS OF STYRENE IN IRRADIATED ORGANIC GLASSES. Irie, M. (Kyoto Univ.); Nakahigashi, N.; Yoshida, H.; Okamura, S. Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 5: 20-25(Aug 1972).

Ion radicals of styrene and their reaction in organic glass matrices with different viscosities were studied at 77°K to reveal the initiation mechanism of radiation-induced ionic polymerization of styrene by means of optical absorption measurements. Anion radical of styrene, formed in γ-irradiated 2-methyltetrahydrofuran glass at 77°K, abstracts proton from the matrix to form a styryl radical and cannot initiate anionic polymerization. In n-butyl chloride glass cation radical of styrene was formed. It reacts with styrene to produce a secondary intermediate, which gives the absorption at 460 nm. The reaction is supposed to be the initial process of the cationic polymerization of styrene. (auth)

23669 RADIATION-CHEMICAL DEGRADATION OF METHYL-^{14}C-CYCLOPENTANE. Keszei, C. (MTA Izotop Intezete, Budapest). Izotoptechnika; 17: No. 7, 361-368(Jul 1974). (In Hungarian).

Determination of the types and probability of radiation chemical degradation of the original molecule into fragments by isotopic tracer techniques is described. (auth)

23670 ESR STUDY OF RADIATION-INDUCED DEFECTS IN 1-METHYL URACIL. Herak, J. N.; Dulcic, A. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)). pp 427-429 of Magnetic Resonance and Related Phenomena. Hovi, V. (Ed.). Amsterdam; North-Holland Publishing Company (1973).

From 17th congress AMPERE on magnetic resonance and related phenomena; Turku, Finland (21 Aug 1972).

1-Methyluracil is a constituent of RNA and this is the first report on radiation-induced damage in one of the uracil constituents of RNA. The crystals of 1-methyluracil are composed of planar molecules, lying in the plane determined by the crystallographic axes b and c. Irradiation was carried out using a ^{60}Co-source at liquid nitrogen or room temperature, and the spectra were taken with a Varian E-2 spectrometer. (auth)

23671 ESR STUDIES OF FORMATION AND TRAPPING OF FREE RADICALS IN X-IRRADIATED LEUCINE SALTS. Lassmann, G.; Damerau, W. (Deutsche Akademie der Wissenschaften zu Berlin (German Democratic Republic). Inst. fuer Molekularbiologie). pp 430-432 of Magnetic Resonance and Related Phenomena. Hovi, V. (Ed.). Amsterdam; North-Holland Publishing Company (1973).

From 17th congress AMPERE on magnetic resonance and related phenomena; Turku, Finland (21 Aug 1972).

The trapping of free radicals formed by ionizing radiation in the solid state depends on the size of the species, the temperature, and the kind of lattice. The usual manner to distinguish different radical types with overlapping spectra is the stepwise annealing of the sample. The formation of radicals by x irradiation of leucine HCl and leucine DBr at low temperature and the trapping of formed species in different types of lattices were studied. (auth)

23672 V CENTERS AND HYDROGEN ATOMS IN IRRADIATED HYDRAZINIUM DIHALIDES. Rogers, M. T.; Watson, J. C. (Michigan State Univ., East Lansing (USA). Dept. of Chemistry). pp 532-534 of Magnetic Resonance and Related Phenomena. Hovi, V. (Ed.). Amsterdam; North-Holland Publishing Company (1973).

From 17th congress AMPERE on magnetic resonance and related phenomana; Turku, Finland (21 Aug 1972).

A number of hydrazine salts were irradiated and the ESR spectra revealed a number of nitrogen-containing radicals; however, most of these investigations were made at room temperature or on powders. An ESR study of single crystals of $N_2H_6Cl_2$, $N_2H_6Br_2$, and $N_2H_6F_2$, which were γ-irradiated at 77°K and the spectra taken without warm-up, is reported. (auth)

23673 IRRADIATION DECOMPOSITION OF PCB. Shinozaki, Y. (Tokyo Metropolitan Isotope Research Center). Kagaku Kogyo; 24: No. 12, 1610-1616(Dec 1973). (In Japanese).

Irradiation of neutral 0.3 vol. % PCB solutions caused no chain reaction of decomposition of the PCB. The energy yield in irradiation decomposition (G) was about 1. However, irradiation of the 0.3% PCB in 2-propanol containing 0.01 mole/l. NaOH decomposed the PCB by chain reaction. The value of G was as large as 170. When the alkali concentration was 0.08 mole/l., the value of G reached 670. The decomposition products were sodium chloride or potassium chloride depending upon the nature of the alkali used, and acetone and biphenyl. A small amount of water was produced simultaneously. The decomposition efficiency increases up to the concentration of 2% PCB, but remains unchanged with the further increase of the PCB concentration. The increase of alkali concentration up to 0.7% is effective to increase the decomposition efficiency. When transformer oil was irradiated, benzene trichloride in the oil did not decompose up to the irradiation of 10^{19} eV/g. At the dose of 2.6×10^{19} eV/g when most PCB disappeared, benzene trichloride decomposed only about 30%. The addition of metallic sodium to form alcolate reduced the efficiency of decomposition of PCB. Hydrogen flame gas-chromatography indicated the presence of biphenyl acetone, sodium chloride, monochlorobiphenyl, dichlorobiphenyl, phenyl cyclohexadiene, benzene, and trichlorobenzene in the decomposition products. The addition of biphenyl to the 2-propanol solution of PCB decreased the dechlorination efficiency. Also the rise of temperature was unfavorable to the decomposition of PCB. Explanation is given on the mechanism of decomposition reaction. (JA)

23674 ADSORPTION OF MINERAL ACIDS ON ALUMINA IRRADIATED IN THE NUCLEAR REACTOR. Jacimovic, L.; Stevovic, J.; Veljkovic, S.; Galonja, M. (Belgrade Univ.). Isotopenpraxis; 10: No. 6, 224-226(Jun 1974).

Adsorption of telluric, phosphoric, and molybdic acids on alumina was affected by irradiation of oxide in the nuclear reactor. The main changes include reduced adsorption capacity and lowering of pH values of aqueous suspensions of alumina. Both were reproduced by using nonirradiated alumina treated with 2.7×10^{-1} M HCl. Induced acidity of alumina could be decreased by irradiation without free access of the surrounding atmosphere to the samples. The presence of an inert gas ensured efficient protection of alumina. These reactions were discussed on the basis of the highly hydroxylated surface of alumina, which may be affected by radiolysis and by interaction with gaseous radiolytic products. Wider application of alumina could be achieved on the basis of these results. (auth)

23675 ELECTRON–ELECTRON DOUBLE RESONANCE INVESTIGATIONS OF IRRADIATED MALONIC ACID-D_4 SINGLE CRYSTALS. Kispert, L. D.; Wang, P. S. (Univ. of Alabama, Tuscaloosa). J. Phys. Chem.; 78: No. 18, 1839-1844 (29 Aug 1974).

Intense deuterium electron–electron double resonance (eldor) spectra were obtained from irradiated malonic acid-d_4 single crystals over a temperature range from –60 to 60°. This is in contrast to the previous investigation of partially deuterated radicals in irradiated l-alanine which showed intense eldor lines at the proton hyperfine frequency while the intensity of the eldor lines at the deuterium hyperfine frequency was either weak or not observable. This was attributed to an increase in the nuclear relaxation time resulting from the smaller nuclear moment of deuterium. The intense deuterium eldor lines (upward of 40% of the esr height) of irradiated malonic acid-d_4 were found to result from the torsional motion of the CD_2-group in $\cdot CD_2COOD$. This motion gave rise to two equivalent deuterium nuclei above room temperature and produced a cross-relaxation time between the nearly degenerate esr energy levels competitive with the electron spin-lattice relaxation time. Only weak deuterium eldor spectra were recorded for $CD(COOD)_2$ due in part to the cross-relaxation time being longer than the spin-lattice relaxation time. This difference in cross-relaxation times permitted a separation of the overlapping spectra of $\cdot CD_2COOD$ and $\cdot CD(COOD)_2$. In general these results suggest that deuterated or partially deuterated radicals observed in irradiated crystals tend to give rise to weak deuterium eldor spectra unless torsional motion of a completely deuterated substituent is present. In addition, overlapping spectra of two or more radicals near room temperature can be separated by eldor techniques providing the spin-lattice relaxation time is considerably shorter than all other relaxation times for one of the two or more radicals. (auth)

23676 AMYLOSE AND AMYLOPECTIN GRAFT POLYMERS BY MUTUAL SOLUTION IRRADIATION AND EFFECTS OF GAMMA-IRRADIATION ON STARCH AND STARCH FRACTIONS. Hofretter, B. T. Raleigh, NC; North Carolina State Univ. (1973). 198p. University Microfilms Order No. 74-18,999.

Thesis (Ph. D.).

A study was undertaken to determine means for preparing structurally uniform graft polymers from the isolated molecular fractions, linear amylose and branched amylopectin, using high-energy radiation. Eleven graft polymers were prepared by mutual gamma irradiation of starch fractions (isolated by n-butanol complex formation) and acrylamide. The mutual procedure was used as trapped-radical yields in irradiated solid amylose were very low. Procedures were developed that permitted satisfactory separations of graft polymer and homopolymer from irradiated solutions. Polyacrylamide add-ons of 6 to 20% were obtained with graft molecular weights of 100,000 to 700,000. The effects of dose, dose rate, ratio of substrate to acrylamide, solvent, temperature, and dissolved oxygen on graft polymer syntheses were investigated. Graft polymer properties that were determined included solution viscosity, extent of wood fiber (pulp) adsorption, inter-fiber bonding, and fiber flocculating tendencies. A number of experiments were performed that indicated true grafting by secondary valence bonding was obtained by the simultaneous solution irradiations. Effects of radiation on starches and starch fractions in both solid and solution form were determined. Radiation energy required for amylose scission (0°C, dry, under nitrogen) was relatively high at 52.6 electron volts, compared to values for chemically similar substances such as cellulose. The generation of functional groups and extents of retrogradation of amylose in irradiated aqueous solutions were measured. Starch was irradiated and the effects on gelling, hot and cold paste viscosity, and film-forming properties studied. No evidence for direct cross-linking by irradiation was obtained. Alkali-sensitive structures are introduced into polysaccharides by radiation with an apparent G value of 2.3. Alkaline degradation of irradiated amylose results from reaction of alkali with beta-alkoxycarbonyl structures. Facile control of viscosity reductions of starch can be achieved by a combined irradiation and alkaline treatment. Starch products so obtained were demonstrated to be good surface sizing agents for paper. Trapped-radical content of irradiated starch granules was estimated by a chemical method developed in the present work that was based on stable radical DPPH. Irradiated starch dissolved in a nitrogen-saturated DPPH solution in 90% dimethyl sulfoxide at room temperature reduced DPPH in proportion to absorbed dose. The $G_{scission}$ for amylose irradiated in 98.8% dimethyl sulfoxide and in solid form is 2.3 and 1.9, respectively. In water the value is 30. A computer program was prepared that calculated intrinsic viscosity from raw data. The output includes the 95% confidence interval of the intrinsic viscosity. (Diss. Abstr. Int., B)

23677 RADIOLYSIS OF DEUTERIUM OXIDE VAPOR: MECHANISMS FOR THE PRODUCTION OF HD-MOLECULES IN THE PRESENCE OF PROTIUM AND PROPANE RADICAL SCAVENGERS. Richter, H. W. Columbus, OH; Ohio State Univ. (1974). 802p. University Microfilms Order No. 74-17,387.

Thesis (Ph. D.).

A major product of the primary and secondary reactions occurring in the radiolysis of deuterium oxide vapor is deuterium atoms. It should be possible to determine the yield of D atoms by measuring the yield of HD molecules resulting from D-atom scavenging by protium or perprotiopropane; however, the results of the present investigation show that when protium is used, HD is formed by an additional path. That is, HD is produced when H-atoms (formed via $D + H_2 \rightarrow HD + H$) recombining at the vessel wall undergo an isotope exchange reaction with adsorbed deuterium oxide prior to recombination. The data indicate that the yield of D atoms determined using perprotiopropane is correct. (Diss. Abstr. Int., B)

23678 SECOND-ORDER DIFFUSION-CONTROLLED REACTION. Decay of Allyl Free Radicals in Irradiated Polyethylene. Wen, W. Y.; Johnson, D. R.; Dole, M. (Baylor Univ., Waco, TX). J. Phys. Chem.; 78: No. 18, 1798-1804(29 Aug 1974).

Based on the Smoluchowski-Waite equation for diffusion-controlled second-order reactions a simple method is described for distinguishing between reactions which are diffusion controlled and those which are not. The limitations of this method are discussed and the method applied to the decay of allyl free radicals in γ-irradiated bulk, single crystalline, and extended chain samples of polyethylene. Diffusion coefficients of the allyl free radical are extraordinarily small, of the order of 10^{-16} to 10^{-18} cm^2 sec^{-1}, while the size of the reaction cage varies from about 5 to 50 Å in the different samples. The activation energy of diffusion is considerably greater in the single crystal samples than in the bulk film, but the decay rate at the highest temperature is about 10-fold greater in the single crystals. (auth)

23679 RADIATION INDUCED HOMOLYTIC AROMATIC SUBSTITUTION. II. Hydroxylation and Phenylation of Benzene. Eberhardt, M. K. (Puerto Rico Nuclear Center, San Juan). J. Phys. Chem.; 78: No. 18, 1795-1797(29 Aug 1974).

The γ radiolysis of aqueous benzene solutions was investigated. Besides the previously reported products phenol and biphenyl we find substantial amounts of dicyclohexadienes, phenyl-2,5-cyclohexadiene, and phenyl-2,4-cyclohexadiene. The G values of these products are dependent on pH, but are independent of dose rate (480 to 65 rads/min). The two phenylcyclohexadienes are formed in approximately the same proportions as in the thermal decomposition of benzoyl peroxide in dilute benzene solution. This suggests the involvement of phenyl radicals in the radiolysis. In presence of Fe^{3+} the phenylcyclohexadienyl radicals and the hydroxycyclohexadienyl radicals are oxidized to biphenyl and phenol, respectively. Another mechanism for the formation of phenylcyclohexadienes involving combination of cyclohexadienyl and hydroxycyclohexadienyl radicals is discussed. (auth)

23680 INTERACTION OF HYDRATED ELECTRONS WITH PHENYLALANINE AND RELATED COMPOUNDS. Mittal, J. P.; Hayon, E. (Army Natick Labs., MA). J. Phys. Chem.; 78: No. 18, 1790-1794(29 Aug 1974).

The reaction rate constants κ of e^-_{aq} with various phenylalanine peptides and related compounds were determined by pulse radiolysis at different pH values, taking into consideration the ionization constants of the functional groups present in these molecules. The k values decrease with deprotonation of the terminal $-NH_3^+$ groups, and increase with increase in the number of peptide linkages. The interaction of e^-_{aq} with these peptides is suggested to take place mainly by addition to the carbonyl group of the peptide. Both deamination and addition to the aromatic nucleus was found to occur. This conclusion was reached based on the observation and identification of the intermediates produced under pulse radiolytic conditions. From the characteristic transient optical absorptions and extinction coefficients of these radicals, it is found that ~40-60% of e^-_{aq} react with phenylalanine peptides leading to deamination while the remainder add to the aromatic ring. While deamination reactions of aromatic amino acids cannot be readily "repaired," the cyclohexadienyl type of radical produced by e^-_{aq} addition to the ring followed by protonation could, in principle, be repaired by a one-electron oxidation to an acceptor molecule with a higher (more positive) redox potential than that of the radical. (auth)

23681 METHYL RADICAL-METHANESULFENATE ANION PAIRS FORMED BY DISSOCIATIVE ELECTRON CAPTURE IN γ-IRRADIATED CRYSTALLINE DIMETHYL-d_6 SULFOXIDE AT 77°K. Chung, Y. J.; Nishikida, K.; Williams, F. (Univ. of Tennessee, Knoxville). J. Phys. Chem.; 78: No. 18, 1882-1884 (29 Aug 1974).

ESR results on the nature of intermediate species produced in the γ-irradiation of dimethyl-d_6 sulfoxide (DMSO-d_6) were consistent with a methyl radical which has a spin density of less than unity in the carbon 2p orbital as observed previously in the case of the methyl radical-bromide ion pair. Thermal annealing and photobleaching studies provided independent proof that the septet ESR spectrum and the 540-nm absorption belong to the same intermediate species. It is proposed that the observed intermediate is the methyl radical-methanesulfenate anion pair held together in the crystalline lattice after dissociation of the unstable Me_2SO^- species. Attempts to observe the corresponding species in γ-irradiated DMSO-h_6 were unsuccessful. (JGB)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 24148.

23682 (COO-3246-14) RESEARCH IN NUCLEAR CHEMISTRY. Annual Progress Report, September 15, 1973-September 14, 1974. Kaplan, M. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Chemistry). Jul 1974. Contract AT(11-1)-3246. 84p. Dep. NTIS $7.25.

The nuclear chemistry research program at Carnegie-Mellon University encompasses studies of nuclear properties, nuclear reactions, nuclear transitions and decay, and the hyperfine interactions of nuclear moments with the extranuclear environments in molecules, crystals, and amorphous substances. Gamma-ray angular correlation studies in the decay of ^{75}Se, ^{181}Hf, and ^{73}As yielded data on the transition properties in the daughter nuclei ^{75}As, ^{181}Ta, and ^{73}Ge, and possibilities are being explored for the adaptation of these transitions to hyperfine interaction measurements. Antiferromagnetic ordering and spin-flop transitions were investigated in single crystals of $CoCl_2 \cdot 6H_2O$ by using the Moessbauer resonance technique, and a comparison was made between emission spectra and absorption spectra. Detailed experiments were carried out on dilute Fe^{3+} ions in quick-frozen HNO_3 solutions, and the observed Moessbauer resonance spectra

revealed striking effects of pH and applied magnetic fields. (23 figures, 3 tables) (auth)

For title listings of selected papers see: 25597 and 25598.

Hot-Atom Chemistry

23683 (AED-CONF-73-402-019) CHEMICAL EFFECTS OF VARIOUS RADIOACTIVE DECAY PROCESSES OF DIFFERENT Ce ISOTOPES WHICH ARE COMPLEXED WITH POLYAMINO-POLYCARBONIC ACID LIGANDS. Beyer, G. J.; Khalkin, V. A.; Herrmann, E. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 15p. (In German). INIS. (CONF-730961-3).

From seventh international hot atom chemistry symposium; Juelich, F. R. Germany (10 Sep 1973).

2 figs.; 4 tabs.; 20 refs. With abstract.

The systems studied are: 1) $^{144}Ce/^{144}Pr$, 2) $^{134}Ce/^{134}La$, 3) $^{131m}/^{131g}Ce$, 4) $^{135}Ce/^{135}La$, and 5) $^{143}Ce/^{143}Pr$. An almost 100% rupture of chemical bonds is obtained as a result of electron-capture decay and converted gamma processes in cerium nuclides, which are complexed with polyamino-polycarboxylic acid ligands. In about 20% of gamma disintegrations the β^- processes result in bond rupture by way of "electron shake off". This process, too, is independent of the complex ligand. In about 80% of the pure β^- disintegrations daughter ions in the oxidation state 4^+ are formed, which stabilize by means of normal redox reactions in the 3^+ state. The daughter ions can leave the complex by exchange reactions according to the kind of ligand as well as the conditions of solutions. (GE)

23684 (COO-584-53) REACTIONS OF 10 keV T^+ AND T_2^+ WITH PROPENE AT 77°K. Progress Report, November 15, 1973–November 30, 1974. Moser, H. C. (Kansas State Univ., Manhattan (USA). Dept. of Chemistry). 1974. Contract AT(11-1)-584. 5p. Dep. NTIS $4.00.

A thin film of propene was condensed at 77°K on a glass target. Tritium gas was ionized at a tungsten tip positioned at a distance of 2 cm from the target. The target was maintained at near ground potential and the tungsten tip was connected to the positive pole of a high voltage power supply, which had a variable output. Reactions were carried out for periods of 1 to 3 minutes at tritium ion currents of 1.0×10^{-9} A. The reaction products were separated by gas chromatography and the amount of tritium in each product measured using an ionization chamber. The principal reactions that occurred were substitution of T for H or for CH_3. (MCG)

23685 HOT-ATOM CHEMISTRY OF ^{60}Co IN THE MIXED CRYSTAL SYSTEM OF COBALT AND METAL-FREE PHTHALOCYANINES. Kujirai, O.; Ikeda, N. (Kyoiku Univ., Tokyo). Radiochem. Radioanal. Lett.; 18: No. 4, 197-202 (21 Aug 1974).

The behavior of ^{60}Co hot atoms in the mixed crystal of cobalt and metal-free phthalocyanines was studied. It was found that the initial retention and the thermal annealing behaviors are different between α- and β-modifications of mixed crystals. It seems that the chemical reactions that determine the initial retention differ from the thermal annealing reactions. (auth)

23686 REACTIONS OF RECOIL ^{13}N ATOMS IN THE GAS PHASE. Stewart, G.W.; Dymerski, P.P.; Hower, C.O. (Department of Chemistry, University of Idaho, Moscow, Idaho). J. Chem. Phys. 61: No. 2, 483-490 (15 July 1974).

Recoil reactions of ^{13}N atoms in CO_2, N_2, O_2, N_2O, and NO were studied. Recoil nitrogen atoms were generated by the $^{12}C(d, n)^{13}N$ reaction using CO_2 as the target molecule. The only products observed were ^{13}NN and ^{13}NNO. Other products sought but not detected were NO, NO_2, and CN radicals. The ^{13}NN formation with added N_2 is attributed to an exchange reaction involving translationally excited nitrogen atoms with nitrogen molecules. The ^{13}NNO yield is independent of CO_2 concentration; however, it increases rapidly with the addition of O_2. This increase, along with an equal decrease in the ^{13}NN yield, is explained by the reaction of excited nitrogen molecules ($^{13}NN^*$) with O_2. It is concluded that recoil ^{13}N atoms do not react directly with CO_2. (auth)

23687 MOESSBAUER SPECTROSCOPY OF REACTOR-IRRADIATED AND ^{119m}Sn-LABELLED $SnSO_4$. Friedt, J. M.; Vogl, W. (Technische Univ., Munich). Phys. Status Solidi (a); 24: No. 1, 265-273 (16 Jul 1974).

The Moessbauer emission spectra of neutron-irradiated $^{118}SnSO_4$ (at 330 and 4.6°K) and of $^{119m}SnSO_4$ as well as the absorption spectra of reactor-exposed $SnSO_4$ were measured. Thermal annealing experiments were performed on low temperature irradiated materials. In all spectra the same anomalous species appear, i.e. Sn^{4+} and a new Sn^{2+} site with Moessbauer parameters differing from those of normal Sn^{2+} in $SnSO_4$. (auth)

23688 FAST SEPARATION IN THE GASEOUS PHASE OF Ru RECOIL PRODUCTS PRODUCED BY ^{252}Cf. II. Boegl, W.; Buettner, K.; Baechmann, K. (Technische Hochschule, Darmstadt, Ger.). Radiochem. Radioanal. Lett.; 18: No. 5, 315-322 (21 Sep 1974).

The separation of Ru nuclides in the gas phase has been investigated. The total yields are given as a function of the gas composition, the temperature of the cooling trap and the temperature of the transfer tube. (auth)

23689 RECOIL AND IMPLANTATION OF RADIO-RHENIUM IONS IN POLY- AND SINGLE CRYSTALLINE HEXAHALOMETAL COMPLEXES. Roessler, K.; Pross, L. (Kernforschungsanlage, Juelich, Ger.). Radiochem. Radioanal. Lett.; 18: No. 5, 291-299 (21 Sep 1974).

The product distribution of Re-recoils from (n,γ) and (n,xn) reactions has been studied in poly- and single crystalline $K_2[ReCl_6]$ and $K_2[ReBr_6]$. Smaller retentions in the latter system are due to the reduced chance of Re-halogen combination with decreasing Re-halogen bond energy. The amount of retention depends strongly on the probability of recombination with some of the former primary ligands. Differences in the product yields of various Re-isotopes originate from recoil range effects. Implantation of Re-ions into $K_2[SnCl_6]$ leads to similar product spectrum as Re-coil in $K_2[ReCl_6]$, whereas on implantation into KCl no formation of $[^*ReCl_6]^{2-}$ is observed. Obviously, a hexacoordinated complex can only be established in a corresponding matrix. (auth)

Properties of Radioactive Materials

Refer also to abstracts 23549, 23553, 23591, 23593, 23615, 24421, 24423, 24429, 24455, 24562, and 25909.

23690 (IAE-2328) STUDY OF THE STABILITY OF THE PROCESS OF FLUORINATION OF U_3O_8 IN A FLUIDIZED BED. Lebedev, O. G.; Murashov, M. V.; Prusakov, V. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 23p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The phenomenon of breakdown of the stability of the pseudo-liquefaction observed during fluorination of U_3O_8 in a fluidized bed (Al_2O_3) at high concentrations of the reagent was studied. From an analysis of the agglomerates formed, overheating of the particles of solid reagent, initiating the accelerated fluorination of the Al_2O_3 particles with subsequent combining with their reaction products, seems the cause of the caking. On the basis of the theory of the heat regime of heterogenic exothermal reactions and from assumption on "package" pseudoliquefaction, the presence of critical conditions in this system causing disruption of the heat regime of the reacting particles in the high temperature region was established. The existence of a region of combination of the reagent concentration, guaranteeing the stability of the fluorination process, was established experimentally. The stability conditions are expressed by the formula $C_{F_2}(C_{U_3O_8}\theta_{U_3O_8})^{0.35} < 170$, where C_{F_2} is the concentration of the fluorine at the reactor inlet in vol %, $C_{U_3O_8}$ is the weight content of U_3O_8 in the fluidized bed in U_3O_8/kg of the fluidized bed, $\theta_{U_3O_8}$ is the specific surface of U_3O_8 in m^2/kg U_3O_8. The data were obtained at a temperature of 500°C, rate of the liquifying agent of 0.11 to 0.20 m/sec, C_{F_2} = 40 to 80 vol %, and $C_{U_3O_8}\theta_{U_3O_8}$ = 10 to 80 m^2/kg fluidized bed. (tr-auth)

23691 (IAEA-R-977-F) QUALITY CONTROL OF COMPOUNDS LABELLED WITH ^{99m}Tc. Part of a Coordinated Research Programme on Radiopharmaceuticals. Final Report, 1 March 1971–29 February 1972. de Castiglia, S. G.; Cembal, S. J.; de Suarez, A. H. F.; Nicolini, J. O.; Noto, M. G.; Mitta, A. E. A. (International Atomic Energy Agency, Vienna (Austria)). Jul 1972. 6p. (In Spanish). INIS.

Control of radiochemical purity and pharmacological conditions such as osmotic pressure, pH and particle sizes of technetium compounds are described. Sterility, toxicity and pyrogen tests were also performed. ^{99m}Tc used in the labelling procedures was obtained: first from Mo-Tc commercially available generators and second, by MEK extraction from alkaline solution of molybdene. This second procedure led us to determine the MEK concentration that could remain in the Tc solution to evaluate the biological hazards that it would imply. A method to evaluate the MEK concentration in the pertechnetate solution is described. Biological distribution assays of these compounds were also performed in order to determine their medical usefulness. (INIS)

23692 (INIS-mf-792, pp 108-127) ISOTHERMAL GRAVIMETRIC METHODS IN SOME GAS–OXIDE REACTIONS. Juusela, J. (Outokumpu Oy, Bjoerneborg, Finland). 1972.

The reduction of uranium oxide (U_3O_8) with hydrogen was studied. The experiments were made with a thermobalance using the isothermal method, which made it possible to follow the reactions very accurately at different temperatures and in different hydrogen

atmospheres. Scanning electron microscopy and x-ray diffraction analysis were also used in order to get more precise information about the kinetics and mechanism of the reduction. The isothermal method was found to be very accurate and reliable. In the reduction experiments with triuranium octoxide both fast and slow reactions were followed. With this method different reaction periods were possible to isolate in order to clarify the mechanism. Also reduction kinetics were measured so that for example activation energies could be calculated for the total reduction or for some part of it. (auth)

23693 (LA-5624) DISSOLUTION OF ^{238}Pu IN ENVIRONMENTAL AND BIOLOGICAL SYSTEMS. Patterson, J. H.; Nelson, G. B.; Matlack, G. M. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

Results from our experiments on dissolution rates of $^{238}PuO_2$ and $^{239}PuO_2$ in distilled water and normal saline solution were compared with rates calculated from data in the literature on various PuO_2 dissolution experiments. The initial comparatively rapid dissolution rates were found to vary widely, even between experiments performed ostensibly under the same conditions. In contrast, the lower rate of dissolution, which began a few hours after contact of the oxide with the aqueous medium, was found to be constant and fell within a range of 1 to 6 $ng/m^2 \cdot s$ under widely varying conditions. (auth)

23694 (MLM-2148) CHARACTERISTIC EQUATIONS AND PLUTONIUM. Silver, G. L. (Mound Lab., Miamisburg, Ohio (USA)). 15 Jul 1974. Contract AT-33-1-Gen-53. 29p. Dep. NTIS $4.00.

The general plutonium equilibrium problem was solved in terms of trivalent and tetravalent plutonium. New approaches to the determination of plutonium equilibrium acidity using the concept of nonequilibrium valence state distributions were developed, and tolerable combinations of trivalent and tetravalent plutonium with plutonium oxidation number were explored. The use of characteristic equations for representing elements and reactions has been evaluated, and appears to be best suited to simple chemical systems in which extensive polymerization of species does not occur. (auth)

23695 (ORNL-4966, pp 22-23) PREPARATION OF $^{233}UO_2$. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

23696 (ORNL-4966, pp 49-51) SPECTROPHOTOMETRIC STUDIES OF SOLUTIONS WITH RADIOACTIVE MATERIALS. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

23697 (ORNL-4966, pp 52-53) ACTINIDE OXIDES AND CARBIDES. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

23698 (RFP-2231) USE OF TRICHLOROETHANE FOR DEGREASING BERYLLIUM, PLUTONIUM, AND URANIUM. Musgrave, L. E. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 8 Aug 1974. Contract AT(29-1)-1106. 9p. Dep. NTIS $4.00.

Trichloroethylene used in ultrasonic vapor degreasing can effectively remove undesirable residues left from fabrication and testing operations on beryllium, plutonium, and uranium surfaces, prior to final assembly. However, trichloroethylene reacts with sunlight and air to contribute to photochemical smog, and is subject to regulations under the Environmental Protection Agency (EPA), Washington, D. C. The 1,1,1-trichloroethane appears to be the best possible nonphotochemically reactive replacement solvent for trichloroethylene in cleaning beryllium, plutonium, and uranium. Tests show the amount of residues remaining on metals cleaned with 1,1,1-trichloroethane are similar to the amount of residues found on metals cleaned with trichloroethylene. Surfaces cleaned with 1,1,1-trichloroethane outgas slightly more oil and solvent residues, but significantly less inhibitor residues than surfaces cleaned with trichloroethylene. In addition, 1,1,1-trichloroethane satisfies general requirements of safety and compatibility when working with beryllium, plutonium, and uranium. (auth)

23699 (UCID-15548) TEMPERATURE AND ACID DEPENDENCY OF THE EXTINCTION COEFFICIENTS OF Pu(III) AND Pu(IV) IN 1 M CHLORIDE SOLUTIONS. Woo, L. F.; Elson, R. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Nov 1969. 17p. Dep. NTIS $4.00.

Extinction coefficients of Pu(III) and Pu(IV) in 1 M chloride solutions were measured over a temperature range of about 15 to 45°C and an acid-concentration range of 0.33 to 1.0 M at constant ionic strength. (auth)

23700 SUPPLEMENT TO THE NEW TREATISE OF INORGANIC CHEMISTRY. Volume 2. Protactinium. Pascal, P. Paris; Masson (1974). 171p. (In French).

The atomic nuclear, and chemical properties of Pa are presented in this manual. An extensive bibliography is cited. (FR)

23701 A RAPID AND EFFICIENT METHOD OF RADIOACTIVELY LABELLING L-ASPARAGINASE. Sutkoff, D. R.; Bosmann, H. B. (Rochester Univ., NY). FEBS (Fed. Eur. Biochem. Soc.) Lett.; 42: No. 1, 86-89 (May 1974).

L-asparaginase was labelled with tritium by allowing it to react with uniformly tritiated acetic anhydride in an ice bath. Separation of the compound was performed by gel filtration. The enzyme retained its activity. (NL)

23702 NEPTUNIUM(IV) DOUBLE ORTHOVANADATE AND ORTHOARSENATE WITH ZIRCON-TYPE STRUCTURE. Pages, M. (CNRS, Paris); Meramedjian, N. H.; Freundlich, W. Radiochem. Radioanal. Lett.; 18: No. 4, 211-216 (21 Aug 1974).

The neptunium(IV) double orthovanadates and orthoarsenates: $MNp_2(XO_4)_3$; M = Li, Na have been identified. The progressive substitution of vanadium by arsenic in the $MNp_2(V_{1-x}As_xO_4)_3$ gives rise to a continuous transition, zirconium structure to superstructure, corresponding to the establishment of a cationic order. (auth)

23703 PENTAVALENT URANIUM IONS IN AQUEOUS SOLUTIONS. Musikas, C.; Marteau, M. (CEA, Fontenay-aux-Roses, France). Radiochem. Radioanal. Lett.; 18: No. 4, 165-175 (21 Aug 1974). (In French).

Electrochemical and spectrophotometric studies show that electrolysis of U(VI) at constant potential in thiocyanic media gives stable U(V) solutions. The nature and the stability of U(V) thiocyanic complexes are discussed. (auth)

23704 MAGNETOELECTRIC COMPOUNDS WITH TWO SETS OF MAGNETIC SUBLATTICES: $UCrO_4$ AND $NdCrTiO_5$. Greenblatt, M.; Hornreich, R. M.; Sharon, B. (Weizmann Inst. of Science, Rehovot, Israel). J. Solid State Chem.; 10: No. 4, 371-376 (Aug 1974).

Using magnetic and magnetoelectric (ME) powder susceptibility measurements, the low-temperature magnetic properties of antiferromagnetic $UCrO_4$ and $NdCrTiO_5$ were studied. Their Néel temperatures T_N are 44.5 and 20.5°K, respectively, the Cr^{3+} spin systems of both materials ordering cooperatively at T_N. Below T_N, the U^{5+} and Nd^{3+} moments are polarized due to their exchange interaction with the ordered Cr^{3+}-spins. It is argued that, for both compounds, each of the two spin systems contributes to the ME susceptibilities. They are thus the first known ME materials possessing two distinct magnetic sublattices. The effective magnetic moments calculated from the magnetic susceptibilities are in good agreement with those previously reported by neutron diffraction studies. (auth)

23705 STATE OF THE ART REPORT ON TRANSURANIUM ELEMENTS. Schwochau, K. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Nuklearchemie). Naturwiss. Rundsch.; 27: No. 4, 151-153 (Apr 1974). (In German). 1 ref.

The chemical properties of the transuranium elements and their compounds are briefly reviewed. In particular, stability, chemical properties, and electronic structure of superheavy elements as well as some experiments as to their production and identification are described. (GE)

23706 TWENTY-THIRD MEETING OF THE INTERNATIONAL SOCIETY OF ELECTROCHEMISTRY, STOCKHOLM, SWEDEN, AUGUST 27-SEPTEMBER 2, 1972. Extended Abstracts. Stockholm; International Society of Electrochemistry (1972). 490p. (CONF-720809-(Absts.)).

Separate references were prepared for 9 of the papers presented under the following headings: electrochemical engineering, accelerated corrosion testing with electrochemical methods, electrochemical thermodynamics, electrochemical kinetics, experimental methods in electrochemistry, high-temperature electrochemistry, corrosion, and batteries. (MCG)

For references to individual papers see: 23581, 23592, 23599, 23707-23709, and 24546-24548.

23707 ELECTROCHEMICAL REDOX PROCESSES OF URANIUM IN AQUEOUS SOLUTIONS OF ACETYLACETONE. Cosovic, B. (Rudjer Boskovic Inst., Zagreb); Jeftic, L.; Branica, M.; Galus, Z. pp 192-194 of Twenty-Third Meeting of the In-

ternational Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).

From 23rd meeting of the International Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972). See CONF-720809-(Absts.).

23708 REDOX PROCESSES OF URANIUM (VI) PEROXO COMPLEXES IN ALKALINE HYDROXIDE SOLUTIONS. Zutic, V.; Branica, M. (Rudjer Boskovic Inst., Zagreb). pp 250-252 of Twenty-Third Meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).

From 23rd meeting of the International Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972). See CONF-720809-(Absts.).

23709 EXPERIMENTAL STUDIES OF COMPLEX REACTION MECHANISMS OF URANIUM IN ACIDIC MEDIA. Cukman, D.; Vukovic, M.; Pravdic, V. (Rudjer Boskovic Inst., Zagreb). pp 261-263 of Twenty-Third Meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).

From 23rd meeting of the International Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972). See CONF-720809-(Absts.).

23710 MASS SPECTROMETRIC STUDIES OF GASEOUS ThO AND ThO_2. Hildenbrand, D.L. (Stanford Research Institute, Menlo Park, California 94025); Murad, E. J. Chem. Phys. 61: No. 3, 1232-1237 (1 Aug 1974).

High temperature mass spectrometric techniques have been used to study the equilibria $(1/2)Th(s)+(1/2)ThO_2(s) = ThO(g)$, (1); $ThO(g)+Si(g) = Th(g)+SiO(g)$, (2); $Th(g)+ThO_2(g) = 2\ ThO(g)$, (3). From the equilibrium data and related electron impact measurements the following quantities have been derived: $\Delta_f H(ThO_2,g,298.15\ K) = -4.6\pm5.9$ kJ/mol; $D°_0(ThO) = 848\pm13$ kJ/mol (or 8.78 ± 0.13 eV); $IP(ThO) \geq 6.0$ eV; $\Delta_f H(ThO_2,g,\ 298.15\ K) = -443\pm25$ kJ/mol; $D°_0(ThO_2) 1532\pm30$ kJ/mol (or 15.9 ± 0.3 eV); and $IP(ThO_2) = 8\pm1$ eV. A second-law analysis of Reaction (1) gives a measure of the magnitude of the electronic partition function of ThO. Difficulties in interpreting the ThO ionization threshold are described. The relationship of these measurements to recent kinetic studies is briefly discussed. (auth)

23711 LABELLING OF PROSTAGLANDINES WITH RADIOIODINE AND TESTING OF THE BIOLOGICAL CHARACTERISTICS OF IODINATED DERIVATIVES. Kocsar, L.; Meretey, K.; Virag, S.; Kovacs, G. (Sugarbiologial es Sugaregeszsegugyi Kutato Intezet, Budapest). Izotoptechnika; 17: No. 7, 355-360 (Jul 1974). (In Hungarian).

Prostaglandines retain their immunological in vitro reactivities and, apart from some exceptions, some other important biological characteristics, after iodine labeling. (auth)

23712 RADIOISOTOPIC LABELLING OF PROSTAGLANDINES. Tanacs, B.; Kling, F.; Marton, J. (MTA Izotop Intezete, Budapest). Izotoptechnika; 17: No. 7, 347-454 (Jul 1974). (In Hungarian).

Types and structures of prostaglandines are discussed. Preparation of precursor fatty acids and prostaglandines labeled with ^{14}C and ^{3}H by biosynthesis and prostaglandine conversion is described. (auth)

23713 ENDOR SPECTRA OF $U^{3+}-F^-$ IN CALCIUM FLUORIDE AND STRONTIUM FLUORIDE. Secemski, E.; Low, W. (Hebrew Univ., Jerusalem (Israel). Dept. of Physics). pp 315-317 of Magnetic Resonance and Related Phenomena. Hovi, V. (Ed.). Amsterdam; North-Holland Publishing Company (1973).

From 17th congress AMPERE on magnetic resonance and related phenomena; Turku, Finland (21 Aug 1972).

The ENDOR spectra of $U^{3+}-F^-$ interstitial charge compensator in CaF_2 were previously reported. These measurements were extended to a SrF_2 host lattice, with the intention of learning something about the radial extent of the transferred hyperfine interaction for the 5f electrons, where there is a larger covalency contribution than for 4f electrons. Attempts to extend the measurements to a BaF_2 lattice have so far not succeeded. The results of the interstitial charge compensator F^- ion are given. (auth)

23714 RADIOIMMUNOASSAY OF CONTRACEPTIVE STEROIDS. II. Synthesis of 6,7-^{3}H-Mestranol and Ethinylestradiol of High Specific Activity. Kundu, N. (State Univ. of New York, Buffalo). Steroids; 23: No. 2, 155-163 (Feb 1974).

A simple and convenient method is described for the preparation of tritiated mestranol and ethinylestradiol of high specific activity as a prerequisite in the development of the radioimmunoassay of the unlabelled compounds. Radioactive mestranol was prepared from estrone-6,7-^{3}H (40 Ci/mmole) by methylation followed by ethinylation and purification by TLC. Radioactive ethinylestradiol could not be made from this mestranol by demethylation with boron tribromide, but it could be made directly from estrone-6,7-^{3}H by ethinylation, removing the unreacted estrone by Girard's reagent T and purifying the product by TLC. Purities of these compounds were checked by TLC in two solvent systems and finally by the isotopic dilution technique. The specific activity of the final products was calculated by determining the loss of tritium during each step of reaction with a double isotopic method. (auth)

23715 ^{11}C-LABELLED RADIOPHARMACEUTICALS: SYNTHESIS AND HIGH PRESSURE LIQUID CHROMATOGRAPHY OF NICOTINIC-^{11}C ACID. Machulla, H. J.; Laufer, P.; Stoecklin, G. (Kernforschungsanlage, Juelich, Ger.). Radiochem. Radioanal. Lett.; 18: No. 5, 275-280 (21 Sep 1974).

Carrier-free nicotinic-^{11}C acid was synthesized using $^{11}CO_2$ as precursor from a 13-MeV proton bombarded N_2-gas target. Fast purification was accomplished by means of high pressure liquid chromatography. Overall yields of about 70% were obtained within about 25 minutes. (auth)

23716 NOVEL METHOD OF LABELLING BIOMOLECULES WITH ^{123}I AND ^{125}I. El-Garhy, M.; Stoecklin, G. (Kernforschungsanlage, Juelich, Ger.). Radiochem. Radioanal. Lett.; 18: No. 5, 281-290 (21 Sep 1974).

While direct labelling via the $^{123}Xe(\beta^+,EC)^{123}I$ and the $^{125}Xe(EC)^{125}I$ decay leads to reasonably good radiochemical iodination yields of some 10 to 60% in the case of liquid or molten substrates, such as fatty acids the yields from ^{123,125}Xe-exposure of solid biomolecules such as deoxyuridine, L-tyrosine and insuline are only about 2 to 3%. An extremely effective iodination reagent for these latter systems, however, is obtained, when ^{123,125}Xe is allowed to decay in a crystalline KIO_3 matrix. Upon dissolution in a 0.1 N HCl solution of the organic substrate, immediate iodination is observed. Carrier-free monoiodinated products are obtained with radiochemical yields of 50 to 90%. (auth)

23717 REACTIONS OF BROMINE SPECIES ACTIVATED BY THE $^{82m}Br \rightarrow {}^{82}Br$ AND $^{80m}Br \rightarrow {}^{80}Br$ ISOMERIC TRANSITIONS WITH CYCLOALKYLBROMIDES. Su, Y. Y.; Metcalfe, C.; Ache, H. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Radiochem. Radioanal. Lett.; 18: No. 5, 349-356 (21 Sep 1974).

The products formed following the reactions of recoil bromine species generated by the $^{82m}Br \rightarrow {}^{82}Br$ and $^{80m}Br \rightarrow {}^{80}Br$ isomeric transitions with cyclopropylbromide, cyclobutylbromide and a mixture of methylbromide and cyclobutane were studied in the liquid and gas phase. The product spectrum obtained suggests that the $^{82(80)}$Br for Br substitution process is accompanied by an extensive isomerization and decomposition of the excited $^{82(80)}$Br-cycloalkylbromide formed in the primary substitution step. As expected, stabilization of the excited product occurs more easily in the case of the four membered ring compound than with the more strained three membered ring compound. The ^{82}Br for H substitution in cyclobutane is characterized by complete isomerization and decomposition of the excited ^{82}Br-cyclobutylbromide. (auth)

23718 MOESSBAUER STUDIES OF THE CHEMICAL STATES OF ^{57}Fe IN ^{57}Co-LABELLED M(I[Co(II)(acac)$_3$ COMPLEXES. Wei, H. H.; Takeda, M.; Saito, N. (Tokyo Univ.). Radiochem. Radioanal. Lett.; 18: No. 5, 311-314 (21 Sep 1974).

The effect of alkali metal ions on the chemical states of ^{57}Fe produced by EC decay in ^{57}Co-labelled alkali trisacetylacetonato cobaltate(II) complexes has been investigated by means of Mössbauer spectroscopy. Any charge states of iron atoms higher than +2 were not observed. The isomer shift decreases with the increasing electronegativity of the cation. (auth)

23719 KINETICS AND MECHANISM OF THE DISPROPORTIONATION OF URANIUM(V). Ekstrom, A. (Australian Atomic Energy Commission, Lucas Heights). Inorg. Chem.; 13: No. 9, 2237-2241 (Sep 1974).

The kinetics and mechanism of the disproportionation of U(V) were investigated. In agreement with a previous study (T. W. Newton and F. B. Baker, Inorg. Chem., 4, 1166 (1965)), the rate of disproportionation was observed to be retarded by the presence of U(VI), the effect being attributed to the formation of a $U^V \cdot U^{VI}$ complex whose absorption spectrum in the range 360 to 760 nm was measured. The effect of ionic strength, acid concentration, and the presence of complexing anions on the disproportionation rate was examined. The reaction was also studied in D_2O solution and reaction mechanisms are discussed. (auth)

23720 COMPARATIVE SOLUTION CHEMISTRY, IONIC RADIUS, AND SINGLE ION HYDRATION ENERGY OF NOBELIUM. Silva, R. J.; McDowell, W. J.; Keller, O. L. Jr.; Tarrant, J. R.

(Oak Ridge National Lab., TN). Inorg. Chem.; 13: No. 9, 2233-2237(Sep 1974).

The chemistry of nobelium was examined by comparing its behavior with other elements in solvent extraction and ion-exchange systems, by confirming that its normal valence is 2+ by acid dependence of its solvent extraction behavior, by derivation of its ionic radius using both experimental and theoretical methods, and by calculation of the single ion heat of hydration. In the experimental work about 500 to 1000 atoms per experiment of cyclotron-produced ^{255}No ($T_{\frac{1}{2}}$ = 223 sec) were used. Its extraction behavior in a tri-n-octylamine-HCl system was compared with that of divalent mercury, cadmium, copper, cobalt, and barium, and it was found to be most similar to the relatively noncomplexing alkaline earths. Comparison to the alkaline earths in a cation-exchange resin-HCl system indicated it to be most like Ca^{2+} and comparison with these elements in a bis(2-ethylhexyl) phosphoric acid (HDEHP) liquid-liquid extraction system showed nobelium to have an extraction behavior between that of Ca^{2+} and Sr^{2+}. The extraction of nobelium into HDEHP as a function of pH allowed a direct determination of the valence as 2+ in confirmation of previous indications. The ionic radius of No^{2+} was estimated from a linear correlation of ionic radius with distribution coefficient for several divalent ions. A value of 1.0 Å was obtained from ion-exchange data and 1.1 Å from liquid-liquid extraction data with theoretical calculations giving a value of 1.1 Å. The single-ion heat of hydration, obtained from a Born type calculation, was -355 kcal $(g\text{-atom})^{-1}$. (auth)

Radioactive Waste Treatment

Refer also to abstracts 24792, 24799, 24802, 24805, and 24808.

23721 (ARH-SA-173) REFLUX AMINE FLOWSHEET FOR PLUTONIUM RECOVERY FROM METALLURGICAL SCRAP. Schulz, W. W.; Bouse, D. G.; Kupfer, M. J. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-2130. 32p. (CONF-740917-3). Dep. NTIS $4.75.

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Using the secondary amine, Amberlite La-2®, as extractant, a reflux-type solvent extraction process is being developed for possible application in Hanford's Plutonium Reclamation Facility. A conceptual amine process flowsheet, considerably simpler than the presently used tributyl phosphate flowsheet, has been successfully demonstrated in mixer-settler tests. Amberlite LA-2, either in CCl_4 or trichlorobenzene solutions, is satisfactorily resistant to degradation by HNO_3 and/or HNO_2 solutions. Unidentified ligands that complex Pu(IV) and prevent its stripping with dilute HNO_3 form on alpha radiolysis of the amine extractant. At expected maximum irradiation doses (20-40 watt-hr/liter), however, the concentration of these radiolytic products is small and their adverse effect can be largely overcome by periodic washing of the recycled solvent with HNO_3-HF solutions. (auth)

23722 (CONF-740807-15) IODINE SCRUBBING FROM OFF-GAS WITH CONCENTRATED NITRIC ACID. Yarbro, O. O.; Mailen, J. C.; Groenier, W. S. (Oak Ridge National Lab., Tenn. (USA)). 1974. 12p. Dep. NTIS $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

A new process, named Iodox, for effectively scrubbing all iodine forms from off-gas streams with concentrated (~20 M) nitric acid has been developed. This process removes all significant iodine species, both elemental and organic, from a gas stream by oxidizing them to the nonvolatile iodate form. Advantages of the Iodox system for removing iodine from nuclear fuel reprocessing plant off-gas include: (1) It is capable of removing kilogram quantities of iodine while delivering a concentrated iodine waste stream for permanent disposal. (2) It is relatively insensitive to the contaminants normally found in a reprocessing plant off-gas stream and effectively removes all significant iodine forms. (3) Nitric acid is used in the process; thus no significant chemicals are introduced to the plant process or waste handling systems. Laboratory-scale studies indicate that iodine retention factors in excess of 10^4 for methyl iodide can be obtained in a multistaged bubble-cap column. A small engineering-scale demonstration of the complete process, including the iodine scrubbing column, iodine waste concentration and solid I_2O_5 handling, and acid reconstitution and recycle, is in progress. The flowsheet being used for the engineering-scale system demonstration is typical of an application of the Iodox process to a fuel reprocessing plant. (auth)

23723 (DP-MS-74-2) EFFECT OF ALKALI METAL CONTENT OF CARBON ON RETENTION OF IODINE AT HIGH TEMPERATURES. Evans, A. G. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 14p. (CONF-740807-2). Dep. NTIS $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

Activated carbon for filters in reactor confinement systems is intentionally impregnated with iodine salts to enhance the removal of radioiodine from air streams containing organic iodides. When a variety of commercial impregnated carbons were evaluated for iodine retention at elevated temperatures (4 hours at 180°C), wide variations in iodine penetration were observed. The alkali metal and iodine content of carbon samples was determined by neutron activation analysis, and a strong correlation was shown between the atom ratio of iodine to alkali metals in the carbons and the high-temperature retention performance. Carbons containing excess alkali (especially potassium) have iodine penetration values 10 to 100 times lower than carbons containing excess iodine. Both low I/K ratios and high pH values were shown essential to high efficiency iodine retention; therefore, conversion of elemental iodine to ionic iodine is the basic reaction mechanism. The natural high K^+ content and high pH coconut carbons make coconut the preferred natural base material for nuclear air cleaning applications. Studies show, however, that treatment of low potassium carbons with a mixture of KOH and I_2 may produce a product equal to or better than I_2-impregnated coconut carbons at a lower cost. (auth)

23724 (ORNL-4966, pp 5-13) WASTE MANAGEMENT. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

23725 (ORNL-4966, pp 24-31) SEPARATIONS CHEMISTRY RESEARCH AND DEVELOPMENT. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

23726 (ORNL-4966, pp 68-70) IODINE SORPTION ON CHARCOAL. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

23727 TREATMENT OF RADIOACTIVE WASTES. Hiyama, T. (Japan Atomic Power Co., Tokyo). Karyoku Genshiryoku Hatsuden; 24: No. 5, 553-558(May 1973). (In Japanese).

The treatment and disposal of wastes from nuclear power plants differ largely from those in ordinary industries, due to radioactivity involved. These wastes may be treated variously, but the radioactivity remains as it is. In the treatment, safety as well as economic aspect must be considered. The treatment of radioactive wastes is described on the following, differentiating among gas-cooled reactor, BWR and PWR: occurrence of the radioactivity; treatment of radioactive wastes, including gaseous, liquid and solid wastes, and the level of radioactivity; and development of treatment technology. The radioactivity in nuclear power plants occurs both due to external and internal causes. The sources of radioactive wastes and methods of their treatment differ somewhat among the three types of reactors. To minimize the release of radioactivity into environment, development of better treatment techniques is constantly in progress. (JA)

23728 CEMENT SOLIDIFICATION OF WASTES FROM NUCLEAR POWER STATIONS BY OUT-DRUM MIXING METHOD. Yamaguchi, Y.; Tanimoto, K. (Chubu Electric Power Co. Inc., Nagoya, Japan). Chubu Denryoku K. K. Kenkyu Shiryo; No. 55, 91-100(Mar 1974). (In Japanese).

Concerning the out-drum mixing method for the cement solidification of radioactive wastes from nuclear power plants, the following points have been studied by experiment: mixing performance, adhesion of mixture to a mixer, physical properties of obtained solids, their stability and seawater-resistant property, and temperature rise of the solids due to hydration heat. Radioactive wastes studied in cement solidification were granular ion-exchange resin, powder ion-exchange resin, and filter sludge-concentrated liquid from a BWR plant. Both mixing performance and the physical properties of solids (strength and specific gravity) were satisfactory. Adhesion to a mixer could be reduced greatly by using the water-cement ratio of about 50%, and the adhering portion was removable by injection and stirring of concentrated waste liquid. There was no problem in using concentrated waste liquid instead of fresh water for mixing with resin or filter sludge. By mixing them into the waste liquid little by little, the volume of cement solidification can thus be reduced. (JA)

23729 HIGH LEVEL WASTE. Schneider, K. J. (Westinghouse Hanford Co., Richland, WA). pp 187-233 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

The major methods considered for disposal or long-term stor-

age are: disposal as solids in salt mines, ocean deeps, and ice sheet areas; disposal as liquids in deep wells; storage as solids in deep underground caverns and in man-made vaults at or near the earth's surface; and perpetual storage as liquids in deep underground caverns and in tanks. (LK)

Radioisotope Production

Refer also to abstracts 23627, 24381, and 24437.

23730 (AAEC/E-310) PREPARATION OF MAGNESIUM-28 BY THE IRRADIATION IN HIFAR OF MIXTURES CONTAINING COMPOUNDS OF LITHIUM-6 AND MAGNESIUM-26. Robson, J.; Sorby, P. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1974. 7p. Dep. NTIS (U. S. Sales Only) $4.00.

An examination of the specific activities and yields of ^{28}Mg obtained by the irradiation in HIFAR of a number of mixtures of lithium carbonate with either magnesium carbonate or magnesium oxide showed that up to 0.25 mCi of ^{28}Mg at approximately 6 mCi g^{-1} of magnesium could be obtained. A separation procedure based on the precipitation of magnesium hydroxide is described and the results of a number of preparations by this method are presented. (auth)

23731 (JAERI-M-5413) PROGRESS REPORT OF THE DIVISION OF RADIOISOTOPE PRODUCTION FOR FISCAL 1971. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 67p. (In Japanese). NTIS (US Sales Only).

Research and technical developments in the production of radioisotopes in the Division of Radioisotope Production, Radioisotope Center, for the fiscal year 1971 are described. The study of hot-atom effect to be utilized in radioisotope production and the development of the processing for short-lived radioisotopes from fission products and for ^{14}C and ^{131}I were completed. These works, continued for several years in the past, provide useful information for the actual production. Many advances were also achieved in other areas. For example, systematic isolation of long-lived radioisotopes from the fission products by ion-exchange was successful, and the trial production cell for separation of radioisotopes from fission products by solvent extraction was designed and constructed. Research on the computer analysis of γ-ray spectra applicable in many fields continued. Effect of the analysis will be increased by completion of an on-line data acquisition system in the future. (auth)

23732 (MLM-2152) SEPARATION OF $^{113m}In/^{113}Sn$ PAIR BY RESIDUE ADSORPTION. Blane, D. E.; Kirby, H. W.; Gilbert, T. W. (Mound Lab., Miamisburg, Ohio (USA)). 15 Aug 1974. Contract AT-33-1-GEN-53. 53p. Dep. NTIS $5.45.

Thesis. Submitted by D. E. Blane to Univ. of Cincinnati, Ohio.

A method has been developed for the separation of picogram quantities of the parent-daughter pair, $^{113}Sn/^{113m}In$. The mixture is reacted with concentrated nitric acid in a glass vial and EDTA is used as the desorbing agent which complexes the indium. The complex is removed with a transfer pipette and the degree of separation is determined by gamma counting with a single channel pulse height analyzer equipped with a well-type NaI(Tl) crystal. Separations were obtained ranging from 21.6% indium with no detectable amounts of tin to 94.5% indium with 7.4% tin. (auth)

23733 (ORNL-4966, pp 14-20) TRANSURANIUM-ELEMENT PROCESSING. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

23734 PRODUCTION OF HIGHLY RADIOACTIVE SOURCES OF NEUTRON-DEFICIENT ISOTOPES OF RARE-EARTH ELEMENTS FOR USE IN NUCLEAR SPECTROSCOPY. Molnar, F.; Khalkin, V.; Herrmann, E. (Joint Institute for Nuclear Research, Dubna). Sov. J. Part. Nucl. 4: No. 4, 440-468 (Apr 1974).

Methods are discussed for separation of neutron-deficient isotopes of rare-earth elements from macro quantities of lanthanide targets irradiated with 660-MeV protons. The procedures used were: 1) extraction chromatography with di(2-ethylhexyl) orthophosphoric acid, 2) anion-exchange chromatography from aqueous methane solutions of neutral nitrates, 3) cementation of micro quantities of lanthanides of the cerium subgroup with sodium amalgam, and 4) the Szilard-Chalmers effect in diethlyenetriaminepentaacetate complexes of rare earths. A description is given of the chromatographic separation of the combined highly radioactive sample of nuclear reaction products into individual elements and the preparation of the separated elements for measurement of the conversion electron spectra and for mass separation. (auth)

23735 PREPARATION OF 25 MICROGRAMS ^{144}Ce OF VERY HIGH PURITY. Aumann, D. C.; Zeising, H. (Technische Univ., Munich). Radiochem. Radioanal. Lett.; 18: No. 4, 185-189(21 Aug 1974).

A method for the production of microgram quantities of ^{144}Ce of very high purity is described. The ^{144}Ce is produced as fission product by reactor irradiation of enriched ^{235}U and purified by a lengthy radiochemical separation procedure. (auth)

23736 STUDIES ON THE HEAVIEST ELEMENTS IN DUBNA. Hoffmann, P. (Technische Univ. Darmstadt (F. R. Germany). Fachbereich Anorganische Chemie und Kernchemie). Naturwiss. Rundsch.; 27: No. 2, 68-69(Feb 1974). (In German).

19 refs.

Investigations performed in Dubna with respect to the production, chemical separation, and identification of nielsbohrium, kurchatovium, and superheavy elements are reported. (GE)

Reactor Fuel Reprocessing

Refer also to abstracts 23975, 25823, 25835, and 25959–25962.

23737 (BNL-885) FLUIDIZED BED REPROCESSING OF ROVER FUEL. Reilly, J. J.; Wachtel, S. J.; Johnson, R.; Wirsing, E. Jr.; Hatch, L. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 15 Sep 1964. 45p. Dep. NTIS $5.25.

Declassified 28 Aug 1973.

A fluidized bed volatility pilot plant designed to demonstrate the reprocessing of Rover fuel has been operated with satisfactory results. Unirradiated chopped Rover fuel was reacted continuously with oxygen at 750°C within a fluidized bed of alundum. Carbon was removed as CO_2 while UC_2 and NbC were converted to their respective oxides. After oxidation the bed material was transferred to a fluidized bed fluorinator in which volatile UF_6 and NbF_5 were produced by reaction with fluorine at 450°C. Separation of UF_6 from NbF_5 was effected via partial condensation and selective absorption on NaF. An aqueous alternate to the fluorination step was investigated in which the oxidized bed was leached with nitric acid to dissolve U_3O_8. However, a further leaching step with a hydrofluoric-nitric acid mixture was required to obtain satisfactory (>99%) uranium recovery. (auth)

23738 (CNEA-EN-36/109) DISSOLUTION OF FUEL ELEMENTS. Maroto, A. J. G. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Sep 1973. 51p. (In Spanish). INIS.

A bibliographic review is presented of the chemistry of the dissolution of uranium-based fuel elements. Dissolution in nitric medium, with sodium hydroxide, the STR process, the Zirflex process, the Zircex process, non-aqueous processes, electrolytic dissolution, and the Arco process are described. (tr-auth)

23739 (CS-1262) PROJECT COUNCIL: POLICY MEETING, JANUARY 10, 1944. Cooper, C. M. (Chicago Univ., Ill. (USA)). 4 Feb 1944. 15p. Dep. NTIS $4.00.

Status of the project is reviewed with emphasis on methods of exchanging information, program correlation, personnel training, semi-works process, metallurgy, and processing of irradiated fuel for plutonium recovery. (MCG)

23740 (EUR-4804) INDEPENDENT MATERIAL BALANCE IN A REPROCESSING PLANT BY MEANS OF RANDOM SAMPLING. Farese, L. (Commission of the European Communities, Brussels (Belgium)). 1972. 40p. INIS.

An independent material balance for a reprocessing plant can be established by a safeguards authority by verifying some among the operator's reports on the incoming quantities of nuclear material. It is emphasized that this method is not supposed to quantify the operator's credibility. The operator's more general strategies of diversion, and the inspector's strategies for the detection of a diversion, are studied: the proposed method proves to be satisfactory in each case. Considerations are made on the criteria that should be followed in the choice of the confidence levels, which are to be determined prior to the practical implementation of the method. (INIS)

23741 (GA-A-13064) PROGRESS IN THE THORIUM/U-233 SHIPPING, REPROCESSING, AND REFABRICATION TECHNOLOGY. Brooks, L. H. (General Atomic Co., San Diego, Calif. (USA)). 9 Jul 1974. Contract AT(04-3)-167. 31p. (CONF-740804-3). Dep. NTIS $4.75.

From American Institute of Chemical Engineers; Salt Lake City, Utah, USA (18 Aug 1974).

High-Temperature Gas-Cooled Reactor (HTGR) fuel is being reprocessed by the crush-burn-leach method, which has fewer remote-operation problems than any other technique. A cold reprocessing pilot plant is under construction at General Atomic Company. A hot reprocessing pilot plant is being designed for construction and operation at the Idaho Chemical Processing Plant in 1979. A hot refabrication pilot plant is being designed for construction and operation at the Oak Ridge National Laboratory in 1979. Shipping studies are being performed by General Atomic Company. This paper presents the salient features of

HTGR fuel recycle technology as it exists today, and mentions some improvements that are under investigation. (auth)

23742 (IAEA-R-1025-F) TAMPER RESISTANT MONITORING OF CHEMICAL REPROCESSING PLANTS. Vol. 1. Summary and System Description. Vol. 2. Development of the Leacher Reservoir Monitor System. Vol. 3. Development of the Plutonium Loadout Vessel Monitor System (IAEA/1025RB, ACDA/ST-203, ACDA/ST-219). Final Report, 7 June 1971–30 June 1973. Parsons, B. B.; Durgin, D. L.; Rexford, H. E. (International Atomic Energy Agency, Vienna (Austria)). Aug 1973. vp. INIS.

A tamper-resistant safeguards surveillance system was designed, installed, and tested pre-operationally in the General Electric Co.'s MFRP fuel processing plant. The objectives of the system are to: demonstrate a liquid level measurement system, using the Time Domain Reflectrometry System and to evaluate its usefulness as an accountancy measure and demonstrate the secure and unattended features of TDR data, recording and transmission. The TDR system consists of three main components: the probe, which is installed in the input accountability vessel and plutonium load-out vessel, to sense air to liquid interface, hydrostatic head, and temperature of the vessel contents; the cable, which transmits the source data; and the TDR instrument, which originates the high frequency pulse, receives the response and displays the system signature on an oscilloscope. The system is capable of measuring the total contents of a vessel within 3.66 ± 0.03 mm liquid level. Also batch volumes are measured by the use of before and after transfer level data. In addition to liquid level, the probe provides for temperature and density measurement. The source data and its transmission system will be continuously monitored by TDR and a "signature" will be shown on the oscilloscope and recorded on a chart. Any changes due to penetration or system defects will be immediately detected. (INIS)

23743 (JUL-1073-CT) SCALE-UP OF AN AIR-PULSED MIXER-SETTLER FOR THE REPROCESSING OF NUCLEAR FUELS. Johannisbauer, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). Jun 1974. 110p. (In German). Dep. NTIS (US Sales Only) $8.50.

Starting from a small scale stirred mixer-settler a bench-scale air-pulsed mixer-settler without moving parts is developed. A few preliminary tests demonstrate that it can be used in the JUPITER pilot plant, which is to be built for the reprocessing of the thorium-containing nuclear fuels. To derive scale-up criteria of this mixer-settler model experiments are made of the mass transfer in the mixing chamber, the phase separation characteristics in the settling chamber and the transport of fluids through a mixer-settler stage using two apparatuses of different size. With the aid of the similarity theory a mass transfer equation is formed, which enables the size of the mixing chamber and of the pulsing tubes as well as the operation datas of the pulsing equipment to be calculated. The settling process is described by a model of coalescence, which is used to determine the area of the settling chamber. At last the theory of the hydrodynamic balance yields to the conditions causing the transport of both liquid phases through a mixer-settler battery. Regarding the necessary criticality safety in a nuclear reprocessing plant the size and operation data of an air-pulsed mixer-settler are calculated for the throughput of a prototype plant. (auth)

23744 (KFK-Ext-9/74-1) PROJECT REPROCESSING AND WASTE PROCESSING. Automation in the Analysis of Nuclear Fuels. A Literature Survey from Nuclear Science Abstract. Nessi, B.; Groll, P. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Heisse Chemie; Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Wiederaufarbeitung und Abfallbehandlung). May 1974. 28p. (In German). INIS.

This report is a compilation of references in the Nuclear Science Abstracts, Volume 21, Number 1 to Volume 28, Number 7. (auth)

23745 (ORNL-4966) CHEMICAL TECHNOLOGY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1974. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 103p. Dep. NTIS $5.45.

A separate entry was prepared for 13 of the sections of the progress report. In addition plans for studies on thermal generation of hydrogen are discussed. Work on aqueous processes for LMFBR fuels, HTGR fuel recycle, and HTGR technology and safety programs is no longer covered in this report. (LK)

For abstracts of individual sections see: 23574, 23695–23697, 23724–23726, 23733, 23746, 23747, 23848, 23937, and 24434.

23746 (ORNL-4966, pp 3-4) MOLTEN-SALT REACTOR PROGRAM. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

23747 (ORNL-4966, pp 74-81) MISCELLANEOUS PROGRAMS. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

Progress in the following programs is reported: environmental impact of the nuclear fuel cycle for light water reactors; disposal of ORNL waste by hydraulic fracturing; resource studies; and ^{233}U storage, purification, and distribution. (LK)

23748 (WASH-1248) ENVIRONMENTAL SURVEY OF THE URANIUM FUEL CYCLE. (USAEC Directorate of Licensing, Washington, D. C.). Apr 1974. 277p. Dep. NTIS $17.00.

Off-site environmental effects for each of the fuel cycle operations were analyzed and the data are presented in terms of the annual fuel requirements of a model 1000-MWe nuclear power reactor. Changes incorporated in this updated edition include: enlargement and expansion of the Waste Management section to include data on the proposed near term Retrievable Surface storage Facility, contributions to the general exposure, expansion of the reprocessing chapter to include data from Hanford, Savannah River, and West Valley. Topics covered include: uranium mining, uranium milling, UF_6 production, uranium enrichment, fuel fabrication, fuel reprocessing, radioactive waste management, transportation, and an overview of the total cycle. (MCG)

23749 (Y-1672) RECOVERY OF COATED URANIUM DICARBIDE PARTICLES FROM GRAPHITIZED REACTOR FUEL. Laggis, E. G. (Oak Ridge Y-12 Plant, Tenn. (USA)). 9 Oct 1969. Contract W-7405-eng-26. 37p. Dep. NTIS $5.00.

Declassified 3 Apr 1974.

Pyrolytic carbon-coated particles were recovered, for possible reuse, from Rover reactor fuel elements cured in fabrication to graphitization temperatures. A process was developed for electrolytically disintegrating the high-cured fuel which was inert to the acid digestion used for disintegrating extrusion and low-cured fuel scrap. A particle-recovery pilot-plant system was operated which contained an electrolytic cell where graphitized fuel elements containing approximately 20 wt % enriched uranium were completely disintegrated anodically in a 3.5 to 7.5-molar nitric acid solution at an average rate of 0.63 gram/ampere hour. A total direct current of 190 amperes was supplied to a bank of elements by means of a titanium rod inserted into a fuel coolant channel of each element. The disintegration products were separated by filtration, water elutriation, and screening procedures, and consisted of fine graphite and electrolyte (both of which were low in uranium content), +70 mesh oversize solids, and –70 mesh recovered particle solids. The particle solids contained 67% of the uranium input to the system and consisted of discrete particles diluted by approximately 14% fuel-matrix graphite, including occlusions on the particle surface. Minimizing the generation of oversize solids in the disintegration process was anticipated to increase the particle recovery yield and decrease fuel processing costs for the pilot-plant system projected as a production unit operating at a maximum throughput capacity. (auth)

23750 REPROCESSING OF SPENT NUCLEAR FUEL. Nakajima, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Karyoku Genshiryoku Hatsuden; 24: No. 5, 538-544 (May 1973). (In Japanese).

The reprocessing plants in the world, the outline of the Purex process, and the future trend of reprocessing industry are reviewed. A list of the world's main reprocessing plants in operation or under construction is given including the Hanford Works which was constructed in 1951, and PNC's Tokai Works which will be completed in 1974. Information given includes location, year of construction, operator, owner, objective, fuel type, and reprocessing capacity. In the second part, the Purex process, as applied to the reprocessing of LWR fuel, is explained. Head-end, chemical separation, purification, and the management of radioactive waste disposal are outlined. F. P. nuclides with their half-life and radioactivity per ton of LWR fuel, the production rate of plutonium isotopes, and a decay curve for radioactivity are given for reference. The process chart for the PNC's plant is also shown. In the third part, the technical development being undertaken in the Purex process is discussed from the standpoints of the effective operation of plants and environmental problem. Future trends of American and European plants are also discussed together with the need for increasing reprocessing capacity. Finally, the Japanese program is shortly reviewed. (JA)

23751 REPROCESSING AT THE THRESHOLD OF ECONOMICAL UTILIZATION. Zuehlke, P. (United Reprocessors G.m.b.H., Karlsruhe (F. R. Germany)). Atomwirt., Atomtech.; 19: No. 7, 346-351 (Jul 1974). (In German).

5 figs.

The reprocessing of nuclear fuel has been developed at first independently in different countries for military purposes. In France and Great Britain reprocessing was also done in the framework of the nuclear energy programs. The reprocessing of nuclear fuel has now reached a phase of imminent commercial application. The chance to create a sound reprocessing industry, however, depends on various, partly contradictory presuppositions. According to present prognoses on the increase of nuclear power plants, a reprocessing plant of reasonable size for German requirements could not be fully utilized before 1990. In the next 10 years the West-European market, however, will comply perfectly with the requirements connected with the introduction of large plants. A fungible compromise could be attained between the needs of reactor operators and the economical necessity of reprocessing by coordinating the utilization of plants already existing or being under construction and future investments in Europe. (auth)

23752 FUEL REPROCESSING. Rodger, W. A. (Nuclear Safety Associates, Rockville, MD). pp 177-186 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

The discussion on spent fuel reprocessing covers fuel shipment, shipping containers, shipping regulations, spent fuel reprocessing procedures, and management of radioactive wastes. (LK)

CONTROLLED THERMONUCLEAR RESEARCH

Confinement and Heating

23753 (IPPJ-148) REPORT OF MEETING AND WORKING SESSIONS ON PLASMA HEATING, NAGOYA, JAPAN, 17 JANUARY 1972. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1973. 105p. (In Japanese). NTIS (US Sales Only).

The meeting and working session on plasma heating was held on January 17–19, 1972. Various methods of plasma heating were investigated. Heating by electron cyclotron waves is a highly efficient method, and high temperatures can be obtained by this method. However, this is expensive. Obtainable electron density is limited by the cut-off frequency for microwaves. The lower hybrid wave method was studied and has good heating efficiency. The ion cyclotron wave method was studied in linear fields. Compressible Alfven waves and TTMP methods are discussed. The methods mentioned above are classified as heating by high-frequency waves. Technical problems concerning the high-frequency heating are power source, the structure of exciting system feeding power into plasma vessels and high frequency losses by the walls and others. Other methods of heating are direct current and pulse heating. Turbulent flow heating, joule heating, and theta pinch heating are discussed. Beam injection , laser, and shock methods are also explained. (JA)

23754 (IPPJ-171) METHOD TO MAKE THE rf PLUGGING EFFICIENT IN THE POINT CUSP. Hatori, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Aug 1973. 14p. NTIS (US Sales Only).

It is possible to make the width (radius) of the plasma in the line (point) cusp to the order of the ion thermal Larmor radius, when the plasma is injected from one of the point cusps. To do this, it is indispensable to prevent electrons from flowing back through the line cusp. The thin (slender) plasma is convenient for the rf plugging method. It may be possible to significantly improve the containment of the axially symmetric system by utilizing the cusp geometry together with the rf plugging method. (auth)

23755 (IPPJ-174) THEORETICAL PREDICTION OF THE OBSERVED PLASMA HEATING IN THE COMPRESSION EXPERIMENT OF ITO'S GROUP AT OSAKA UNIVERSITY. Alexeff, I. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Aug 1973. 8p. NTIS (US Sales Only).

A simple, model-independent description of the compression experiment of Ito's group at Osaka University predicts the observed plasma heating and final plasma β to within a factor of two. (auth)

23756 (IPPJ-177) DIFFUSION OF PLASMA CONFINED IN STELLARATOR WITH $\epsilon_t > \epsilon_h$. Miyamoto, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Sep 1973. 8p. NTIS (US Sales Only).

Diffusion of plasma confined in a stellarator is discussed when the field modulation ϵ_t of toroidal curvature is larger than the modulation ϵ_h of the helical field, which is the usual case of a toroidal stellarator with medium aspect ratio. The dependence of the diffusion coefficient on the collision frequency ν in the very low frequency region is different in the cases of $\epsilon_t > \epsilon_h$ and $\epsilon_t < \epsilon_h$. (auth)

23757 (JAERI-M-5431) IONIZATION RATES IN TOKAMAK PLASMAS. Fujisawa, N.; Funahashi, A.; Kasai, S.; Sugawara, T. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 16p. (In Japanese). NTIS (US Sales Only).

The ionization rates of tokamak plasmas were numerically calculated, for measuring the particle confinement time in plasmas. The population of excited levels for hydrogen atoms, ionization rates and photon numbers of H_α and H_β lines were obtained by applying a collisional-radiative model to the tokamak plasmas. These results are compared with those from the USSR and USA. The report may provide useful data in measuring the particle confinement time of JFT-2. (auth)

23758 (UCID-15491) CONFINEMENT OF MICROWAVE PRODUCED PLASMA IN THE HYBRITRON. Munger, R. H.; Hartman, C. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 May 1969. 14p. Dep. NTIS $4.00.

Measurements are described for the confinement of noble gas plasmas (He, Ar, Xe) produced by microwave heating in a stellarator or hybrid multipole stellarator confining fields. The differences in plasma behavior between the stellarator and hybridtron modes appear to be mainly associated with differences in plasma formation. (MOW)

23759 ENERGY ANALYSIS OF THE FAST NEUTRAL FLUX IN RF PLASMA HEATING IN A TOROIDAL MAGNETIC FIELD. Kalinichenko, S.S.; Kalmykov, A.A.; Ochinnikov, S.S.; Tarasenko, V.F.; Timofeev, A.D.; Shvets, O.M. Sov. Phys.–Tech. Phys. 18: No. 10, 1292-1293 (Apr 1974).

The fast neutral flux from a plasma in a toroidal magnetic field, heated by high frequency current, is given. The ion density distribution is determined from the energy spectrum of the fast neutral flux emitted from the plasma. This function turns out to be close to Maxwellian upon thermalization of the energy of the axially asymmetric ion–cyclotron waves in the region of the magnetic beach. An estimate of the maximum ion energy, obtained with a retarding–potential energy analyzer and from the fast neutral flux yields an approximate value of 2 keV. Estimates of the ion energy, obtained by different methods, are in good agreement. (auth)

23760 PLASMA HEATING BY AN ELECTRON BEAM MODULATED AT THE LOWER HYBRID FREQUENCY. Kovnik, O. F.; Kornilov, E. A. Sov. Phys.-Tech. Phys. 18: No. 10, 1284-1287 (Apr 1974).

Ion heating and acceleration and electron heating are observed in a beam–plasma discharge when the electron beam is modulated at the lower hybrid frequency in an open magnetic trap. The ions and electrons are heated by a stochastic mechanism. (auth)

23761 SPACE–TIME INTERACTION OF OPPOSED TRANSVERSE WAVES IN A PLASMA. Cohen, B.I. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Fluids 17: No. 2, 496-497 (Feb 1974).

The interaction of two opposed, intense electromagnetic waves, whose difference frequency approximates the plasma frequency is studied. Plasma heating ensues. Energy is transfered to the lower–frequency wave throughout a uniform plasma, but only in a resonance zone in a nonuniform plasma. (auth)

23762 ELECTRON AND ION HEATING THROUGH RESONANT PLASMA OSCILLATIONS. Koch, P.; Albritton, J. (Laboratory for Laser Energetics, College of Engineering and Applied Science, University of Rochester, Rochester, New York 14627). Phys. Rev. Lett. 32: No. 25, 1420-1423 (24 June 1974).

We present an analytic solution for the resonant oscillations of a cold, inhomogeneous, one–dimensional plasma under the influence of a sinusoidal applied field. The model approximates the response to obliquely incident electromagnetic radiation. Energy can be absorbed collisionlessly through either electron wave breaking or ion bunching, when the driven field is strong or weak, respectively. The two regimes are distinguished by $eE_L \lesssim 0.02Lm^2\omega^2/M$, where L is the plasma scale length and E_L the longitudinal driver. In the weak–driver case, ions with keV energies can be produced in the resonance region. (auth)

23763 ION HEATING AT TWICE THE ION–CYCLOTRON FREQUENCY IN REACTOR–ORIENTED MACHINES. Weynants, R.R. (Laboratorium voor Plasmafysica, Associatie "EURATOM–Belgische Staat," Koninklijke Militaire School, 1040 Brussels, Belgium). Phys. Rev. Lett. 33: No. 2, 78-82 (8 July 1974).

A systematic study is made of the efficiency of first–harmonic ion–cyclotron heating in hot, dense, large plasmas. Promising heating times are derived when the imposed axial wavelength satisfies the rather restrictive high–temperature, high–density limitation $k_z \geq \omega_{pi}{}^2 V_{i0}\omega_{ci}{}^{-1}c^{-2}$ (auth)

23764 STABLE PLASMA DISTRIBUTION IN A HELIOTRON MAGNETIC FIELD. Zykov, V.G.; Il'enko, B.P.; Skibenko, A.I.; Fomin, I.P.; Shtan', A.F. Sov. Phys.–Tech. Phys. 18: No. 9, 1200-1202 (Mar 1974).

Experiments have been carried out in an open magnetic trap of the heliotron type with a magnetic well $U = -\int (dl/B)$ to examine the MHD stability condition $\nabla p \nabla U < 0$. The spatial distribution of plasma density in the trap is investigated at different times by means of Langmuir probes and a microwave interferometer with a movable horn. During the entire decay period (about 2 msec) there are no obvious signs of MHD instabilities. The formation of a stable profile and the maintenance of this in time are explained by the presence of a diamagnetic flux of plasma from the center radially outwards into the annular region of minimum B. (auth)

23765 DIRECT MAGNETOACOUSTIC SHOCK FRONT IN A TRUBULENT PLASMA. I. Aref'ev, V.I. Sov. Phys.–Tech. Phys. 18: No. 9, 1189-1196 (Mar 1974).

The structure of a magnetoacoustic shock front is investigated for the case in which the current flowing at the front is unstable. The development of ion–acoustic instabilities produces turbulent heating of electrons at the front and lowers the conductivity of the plasma. As a result, the leading edge of the shock wave has the form of a step with an abrupt drop in the magnetic field. The thickness of the turbulent

front and the thermal electron energy due to turbulent heating are estimated. (auth)

23766 RADIO-FREQUENCY FIELDS IN MAGNETOACTIVE PLASMA. Skipping, C.R.; McDaniel, D.H.; Oakes, M.E. (Department of Physics, University of Texas at Austin, Austin, Texas 78712). J. Appl. Phys. 45: No. 8, 3374-3379 (Aug 1974).

Electric field componenets produced by a single-turn current sheet concentric with a finite magnetoactive plasma cylinder are calculated for frequencies corresponding to resonant peaks in the series loading resistance near the lower hybrid resonance. The radial electric fields are found to be quite large and to penetrate well into the plasma. Axial electric fields are not negligible for a variety of conditions. Expressions for the field components permit calculations for any azimuthally symmetric distribution of current in the sheet. (auth)

23767 ROLE OF DIAPHRAGM IN THE PARTICLE BALANCE IN A TOKAMAK. Vinogradova, N. D.; Razumova, K. A. (Inst. of Atomic Energy, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 156-157(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 261-264(5 Mar 1974).

A diaphragm of special construction was used to measure the distribution of the hydrogen-line emission near the diaphragm. (auth)

23768 ANGULAR MOMENTUM TRANSFERRED DURING ELECTROMAGNETIC ENERGY ABSORPTION AND EMISSION. Klima, R. (Inst. of Plasma Physics, Prague). Czech. J. Phys.; 24: No. 8, 846-851(1974).

In the framework of classical electrodynamics, the angular momentum transported into (and/or from) a volume bounded by a rotational surface is derived. The dependences of electromagnetic field on space and time, and also the electromagnetic properties of the interacting masses are arbitrary. The results may be useful for the theory of toroidal currents induced by high-frequency heating of plasmas. A connection with the Manley-Rowe equations is given. (auth)

23769 HEATING OF A THETA PINCH AT LOW ELECTRIC FIELD. Newton, A. A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.); Wootton, A. J. Nucl. Fusion; 14: No. 3, 359-363(Jun 1974).

Experimental and numerical results on plasma heating in a theta pinch at low azimuthal electric fields, $E_\theta \lesssim 200\ V \cdot cm^{-1}$, are presented. Energy losses due to partial ionization of the initial plasma, and impurities, are shown to govern the final temperatures obtained. In particular, partial ionization results in a critical value of E_θ below which no effective heating occurs. This effect can be overcome by the use of negative bias fields, which increase the initial ionization and allow additional dissipative heating. At larger values of E_θ the initial heating rate is found to scale with E_θ^2. (auth)

23770 PLASMA TRANSPORT IN TOKAMAK REACTORS. Stacey, W. M. Jr. (Argonne National Lab., IL). Nucl. Fusion; 14: No. 3, 353-358(Jun 1974).

Solutions of the radial particle and energy transport equations in a hypothetical tokamak reactor were investigated. Sensitivity of the solutions to various physical processes was examined. (auth)

23771 EVAPORATION MODEL FOR H_2-CLUSTERS INTERACTING WITH ELECTRONS AND IONS IN A PLASMA. Bottiglioni, F.; Coutant, J.; Fois, M. (EURATOM-CEA, Fontenay-aux-Roses, France). Nucl. Fusion; 14: No. 3, 365-375(Jun 1974).

The evaporation rate of fast hydrogen clusters interacting with plasma particles is evaluated and compared with pellet penetration. It is shown that, because of their small size, only a small fraction of plasma particle energy is dissipated inside the clusters so that the evaporation rate is much less when the cluster size decreases below 10^5 atoms per cluster. These results are fairly consistent with the available experimental data. (auth)

23772 MIXED SNOWPLOW-BOUNCE MODEL FOR SHOCK HEATING IN A STAGED THETA PINCH. Oliphant, T. A. (Los Alamos Scientific Lab., NM). Nucl. Fusion; 14: No. 3, 377-382 (Jun 1974).

A model for shock heating in a staged θ-pinch is constructed which combines the simple bounce and snowplow models. The main result is the comparison of the amount of shock heating obtainable for various idealized driving fields and for various degrees of mixture of bounce and snowplow effects. (auth)

23773 ROLE OF IMPURITIES IN CURRENT TOKAMAK EXPERIMENTS. Vershkov, V. A.; Mirnov, S. V. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 14: No. 3, 383-395(Jun 1974).

The possible consequences of the presence of multiply charged impurities in a tokamak plasma are discussed. The first such consequence is cooling of the plasma column periphery due to line radiation, which may lead to a sharpening of the electrical conductivity profile $\sigma(r)$ and hence of the current density profile $j(r)$, as is observed at high values of n_e. Concentration of highly ionized impurities towards the plasma column axis is a possible competing process, leading to flattening of $\sigma(r)$ or even to a skin effect. From the results of soft (3-10 keV) x-radiation measurements, conclusions are derived about the behavior of impurities at the center of the plasma. It is found that the concentration of impurities can be interrupted by the development of plasma instabilities — especially kink and "disruptive" instabilities. With increasing n_e, T_e and discharge duration, the role of impurities in the shaping of $j(r)$ necessarily increases. At some level, this may cause an additional deterioration in the thermal insulation and stability of the plasma column. (auth)

23774 RUNAWAY ELECTRONS IN THE ORMAK DEVICE. Spong, D. A. (Oak Ridge National Lab., TN); Clarke, J. F.; Rome, J. A.; Kammash, T. Nucl. Fusion; 14: No. 3, 397-404(Jun 1974).

Runaway electron currents of up to 140 kA with energies in the MeV-range and lasting for a tenth of a second were observed in ORMAK. A theory which predicts the production and acceleration of these electrons is presented and compared with recent experimental results. Agreement between the two appears to be good. (auth)

23775 HEATING OF A LARGE CTR-TOKAMAK BY NEUTRAL-BEAM INJECTION. McAlees, D. G.; Conn, R. W. (Univ. of Wisconsin, Madison). Nucl. Fusion; 14: No. 3, 419-429(Jun 1974).

The start-up of a large CTR tokamak plasma at low density using energetic neutral beams is studied. Questions of beam-energy deposition profiles, beam-energy requirements for penetration, and beam-power requirements to achieve ignition or prescribed plasma heat-up rates are examined. A detailed analysis for a particular CTR-system design, using a two-fluid, space-time numerical model to simulate plasma behavior, is reported. The numerical model includes neoclassical ion conduction, pseudoclassical electron conduction, radiation losses, Ohmic heating, thermonuclear alpha-particle heating, and injection heating. It is found that even when the power density deposition profile for beam heating is peaked on the axis, the plasma temperature profiles can have local maxima and thus be inverted in the outer plasma regions. This is caused by the decreased density in these zones. For a specific large system studied in detail (aspect ratio 2.6, plasma radius 500 cm, initial peak density $3 \times 10^{13}/cm^3$), beam energies of 100 keV, 350 keV, and 500 keV are considered. Only the 500-keV beam case yields non-inverted temperature profiles during heating. In all cases, moderate power levels are required to ignite low-density plasmas in times of the order of seconds. In addition, the injection time required to establish a prescribed plasma heat-up rate is examined in detail. In some cases, for a given amount of injected energy, the heat-up rate resulting from low-energy beams is greater than that due to higher-energy beams. Beam-energy and -power requirements for smaller systems are also given. (auth)

23776 ACCESSIBILITY OF THE LOWER HYBRID RESONANCE IN THERMONUCLEAR DEVICES. Brambilla, M. (EURATOM-CEA, Grenoble, France). Nucl. Fusion; 14: No. 3, 327-331(Jun 1974).

The condition for efficient coupling of a high-frequency wave at the lower hybrid resonance is discussed for grazing-angle incidence. Scaling laws are derived, which show that the optimistic results recently produced numerically by Puri and Tutter cannot be extrapolated to densities of thermonuclear interest. It is concluded that the Stix-Golant condition for accessibility remains a necessary condition in practice. (auth)

Diagnostics

Refer also to abstracts 23821, 23877, and 25188.

23777 (IPPJ-178) ELECTRON TEMPERATURE DETERMINATION OF A RELATIVISTIC PLASMA BY LASER SCATTERING. Hayase, K.; Okuda, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1973. 13p. NTIS (US Sales Only).

The relativistic formula for laser scattering from a plasma was derived, and from which the spectra of the scattered light are calculated as functions of the electron temperature and the scattering angle. The spectrum deviates considerably from the Gaussian profile when the temperature is high. The relativistic

effect must be taken into account in the temperature determination at the temperature higher than a few hundred eV, otherwise the temperature is overestimated in the blue side of the spectrum. Simple and accurate methods are presented for obtaining a correct temperature in a relativistic plasma. (auth)

23778 (IPPJ-T-14) NEW METHOD FOR ION SPECIFICATION IN A STEADY STATE MAGNETIZED PLASMA. Saad, H. M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Sep 1973. 8p. NTIS (US Sales Only).

H_3^+ and H_2^+ inside the bulk of a steady state magnetized plasma could be quantitatively measured without serious change in the plasma condition. An instantaneous axial gradient magnetic field is applied at the region under study along the axis. The particles are then accelerated towards the detecting system of the electrostatic analyzer where they arrive at different times since they have the same energy but different masses. The detector and the accelerator, producing the axial gradient magnetic field, are placed outside the plasma volume, therefore a minimal and limited perturbing effect is introduced. (auth)

23779 DETERMINATION OF THE CHANNEL DIAMATER OF A PULSED DISCHARGE USING THE EMISSION SPECTRUM. Fal'kovksii, N.I. (Institute of Electrodynamics, Kiev). Sov. Phys.–Tech. Phys. 18: No. 10, 1324-1326 (Apr 1974).

A method is described for measuring the channel diameter of a pulsed discharge on the basis of the spectral lines of the emission from a transverse cross section of the column. The conditions for which the measurements are valid are examined. The reliability of this method is checked by comparing the experimental data with data obtained by the Schlieren method. (auth)

23780 METHOD OF MEASURING THE VOLUME RECOMBINATION COEFFICIENT IN A POSITIVE COLUMN. Vinogradov, G.K.; Golubovskii, Y.B.; Ivanov, V.A.; Kagan, Y.M. (A. A. Zhdanov Leningrad State University). Sov. Phys.–Tech. Phys. 18: No. 10, 1378-1379 (Apr 1974).

We discuss a method of measuring the rate at which charged particles are lost in a gas discharge at intermediate pressures due to recombination. (AIP)

23781 APPLICATION OF LINE REVERSAL METHOD TO MEASUREMENT OF SHOCK FLOW ELECTRON TEMPERATURE. Jeanmaire, P. (Battelle Geneva, Carouge, Switzerland). Phys. Fluids 17: No. 2, 353-359 (Feb 1974).

The electron temperature of a shock tube magnetohydrodynamic plasma was measured by the line–reversal method. In order to reduce the influence of self–reversal in the cool boundary layer on the measurement, the use of nonresonance lines of the potassium seeding was first explored theoretically, then confirmed by experiment. Best suited lines were selected by integrating the radiative transfer equation over both the wavelength and the width of the shock tube assuming a boundary layer temperature profile. A lower limit to the population density of the upper level of the selected transition (4p–6s) was found from the rate equation for this level. The electron temperature distribution along the plasma column was measured using Moutet's double beam version of the line–reversal method. The measurements show good correspondence between the temporal evolution of the electron temperature in the center of the flow and the generator current. The discrepancy between the measured electron temperature and the gas temperature calculated from the shock Mach number is explained by the occurrence of nonequilibrium ionization. (auth)

23782 INFRARED RADIATION FROM THE DENSE PLASMA FOCUS. Post, R.S.; Marshall, T.C. (Plasma Laboratory, Columbia University, New York, New York 10027). Phys. Fluids 17: No. 2, 452-455 (Feb 1974).

Experimental observations of infrared emission (2–10.6 μm) from a dense plasma focus have been made, along with the standard diagnostics of neutrons, x-rays, and visible light. The thermal bremsstrahlung spectrum has been observed over the range $2\ \mu m \lesssim \lambda \lesssim 6.5\ \mu m$. Occasional bursts of strong, nonthermal, infrared occur for $\lambda \gtrsim 5\ \mu m$ with enhancements up to 10^6 over thermal radiation level. At a filling pressure of 1.6 Torr D_2, the enhanced radiation occurs during the dense pinch stage of the discharge; however, at lower pressure (1.1 Torr), the maximum emission occurs during and shortly after the breakup of the dense pinch. (auth)

23783 MEASUREMENTS OF PLASMA PROFILES USING BERNSTEIN POLYNOMIALS FOR THE SOLUTION OF ABEL'S INTEGRAL EQUATION. Albers, E.; Fussmann, G. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik 2). Z. Phys.; 268: No. 2, 97-102(Jun 1974). (In German).

3 figs.; 1 tab.; 9 refs.

By means of CO_2-laser radiation, electron density profiles of an argon arc device are determined. For the approximation of the measured data, a new numerical method involving Bernstein polynomials was developed, which facilitates a subsequent analytical treatment of the Abel inversion problem. (orig.)

23784 POLYCHROMETER WITH EXTREME REJECTION OF STRAY LIGHT. Siemon, R.E. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Appl. Opt. 13: No. 4, 697-698 (Apr 1974).

A three–grating polychrometer is described. This device has been used to measure temperature by observing light scattered from the plasma in the Scyllac fusion device. (AIP)

23785 DIGITAL PLASMA DENSITY DETERMINING DEVICE. Holly, D.J.; Lovell, T.W.; Sprott, J.C. (The University of Wisconsin, Madison, Wisconsin 53706). Rev. Sci. Instrum. 45: No. 7, 947-949 (July 1974).

A device is described for measuring the time dependent, volume averaged density of a decaying plasma in a large multimode microwave cavity such as is typically used for plasma confinement studies. The technique consists of filling the cavity with microwave radiation and digitally counting the modes observed with a detector as the plasma decays. Since each mode corresponds statistically to a constant density increment, the density at a given time is proportional to the number of modes that appear as the density decays to zero. Experiments in a toroidal octopole show good agreement with density as measured by other methods. (auth)

23786 SPATIALLY RESOLVED MEASUREMENT OF IMPURITIES AND THE EFFECTIVE CHARGE $\bar{Z}$ IN A TOKAMAK PLASMA. Evans, D.E. (United Kingdom Atomic Energy Authority Research Group, Culham Laboratory, Abingdon, Berkshire, United Kingdom); Yeoman, M.L. Phys. Rev. Lett. 33: No. 2, 76-78 (8 July 1974).

Laser-radiation scattering is proposed as a method for measuring impurities in tokamak or toroidal pinch plasmas. A direct measurement of the effective charge for momentum transfer, $\bar{Z}$, appears feasible by this technique.

23787 POSSIBILITY OF MEASURING THE DENSITY IN THE REGION OF COMPRESSION OF A LASER THERMONUCLEAR TARGET BY NUCLEAR-PHYSICS METHODS. Krokhin, O. N.; Nikolaev, F. A.; Sklizkov, G. V. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 214-215(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 389-391(20 Mar 1974).

The feasibility of diagnosing the density of a laser thermonuclear target as it becomes compressed, by determining the change of the positron lifetime prior to annihilation with increasing electron density, is discussed. (auth)

23788 HIGH SENSITIVITY INTERFEROMETRY AT 337μ FOR MEASURING THE ELECTRON DENSITY OF A PLASMA. Veron, D. (EURATOM-CEA, Fontenay-aux-Roses, France). Compt. Rend., Ser. B; 278: No. 11, 463-465(11 Mar 1974). (In French).

In this method, two waves displaced in frequency with respect to one another by the Doppler effect are made to beat. The phase shift is measured in terms of a time interval giving results which are much more accurate than those obtained by amplitude measurements. A sensitivity of 10^{-2} fringes is achieved. (FR)

23789 INVESTIGATION OF THE PLASMA DENSITY DISTRIBUTION IN THE TUMAN-2 INSTALLATION BY THE METHOD OF ACTIVE CORPUSCULAR DIAGNOSTICS. Berezovskii, E. L.; Kislyakov, A. I.; Mikhailov, E. A. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 166-168(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 283-287(5 Mar 1974).

The toroidal installation "Tuman-2" for magnetic adiabatic heating was used to measure the distributions of the plasma density over the small cross section of the plasma pinch for different instances of contraction and expansion. The measurements were made by sounding the plasma with beams of fast hydrogen atoms along different chords of the discharge chamber. It is shown that during the contraction time, the total number of charged particles in the plasma pinch increases by 60 to 90%, owing to the increase in their lifetime. The coefficient of plasma diffusion across the magnetic field, which coincides in the Ohmic heating regime with the Bohm value (8×10^4 cm^2/sec); decreases during the compression time to a value not exceeding 2×10^3 cm^2/sec. (auth)

23790 HOLOGRAPHIC INTERFEROMETRY OF COLLIDING LASER PRODUCED PLASMAS. Rumsby, P. T.; Michaelis, M. M. (UKAEA Research Group, Abington. Culham Lab.). Phys. Lett., A; 48: No. 1, 11-12(20 May 1974).

High density plasmas produced by colliding two laser produced carbon plasmas have been investigated interferometrically using holographic techniques. Electron densities remain in the region of 10^{18} cm^{-3} for about 100 ns. (auth)

23791 PROPOSAL OF A NEW PROCEDURE FOR THE MEASUREMENT OF HIGH ELECTRON TEMPERATURES BY THOMSON SCATTERING. Papoular, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Phys. Lett., A; 48: No. 1, 35-36(20 May 1974).

The spectrum of light incoherently scattered by high temperature electrons is widened, skewed and shifted to the blue. All three effects are temperature-dependent but, presently, only the first is used to measure electron temperatures. This letter shows that the last two effects can also serve, and perhaps more conveniently, the same purposes. (auth)

Kinetics (General)

23792 (IAE-2267) ESTIMATE OF PLASMA PARAMETERS IN ACCELERATION CHANNEL AND COMPRESSION ZONE OF MAGNETOPLASMA COMPRESSOR. Berkov, V. I.; Vinoradova, A. K.; Kovrov, P. E.; Morozov, A. I.; Tokarev, L. G.; Proshin, M. A.; Shchepkin, G. Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 28p. (In Russian). INIS.

The electron density, temperatures, ion velocities, and radiation rate were measured by optical methods. From the experimental data calculations were made of the non-measured parameters (electron velocity and ion temperature) and a general picture was given of processes in the magnetoplasma compressor. (tr-auth)

23793 (IPPJ-151) LECTURE NOTE ON COULOMB COLLISIONS. Nishikawa, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1973. 42p. NTIS (US Sales Only).

Elementary theory is introduced to demonstrate the two basic properties of Coulomb collision. The properties are that the cross section σ decreases rapidly as particle velocity increases, and that the dominant contribution arises from the cumulative effect of small-angle scattering or small-momentum transfer process. Because of the first property, one should often distinguish slow and fast particles. Because of the second property, one often needs to introduce effective collision frequency which depends on scattering angle or momentum transfer required. The velocity dependence of the cross-section was demonstrated by considering only close two-particle collisions. The cumulative effect of the small momentum transfer process is discussed by using a simple collision model. Derivation of collision term is carried out. The Landau's derivation of the collision term is made from Boltzmann's binary-collision integral. This derivation is generalized so as to include collective effect: namely, instead of starting from Boltzmann's equation, one can start from the general Fokker–Planck equation, and derive a kinetic equation which includes both binary collision and particle-wave interaction. The Balescu–Lenard collision term is derived as a special case. Its relation to Landau's equation is also discussed. (JA)

23794 (UCID-15563) CURRENT CTR COMPUTER CODES IN USE AT UCLRL, LIVERMORE. Fowler, T. K.; Byers, J. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1969. 21p. Dep. NTIS $4.25.

The attached compilation is a list of the major computer codes currently used in CTR research at UCLRL, Livermore. A brief description of each code is included. The codes listed here either exist in fully developed form or are in a state of active development. Many of those which are complete are being actively modified to include new effects. (auth)

23795 IMAGE EFFECTS IN BOUNDED PLASMAS. Turner, L. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). Phys. Fluids 17: No. 2, 369-374 (Feb 1974).

Assuming thermodynamic equilibrium and using the BBGKY hierarchy, the configuration space and number density distributions of electrons and ions in a plasma bounded by a charged, perfectly conducting surface are derived. Modifying the conventional Debye-Hückel approach, the method of images is combined with the use of the Gibbs distribution to obtain new results. It is also shown that the addition of a magnetic field cannot produce any net current if thermodynamic equilibrium is assumed. A drift current is exactly canceled by the current produced by the variation in the number density of particles gyrating about their guiding centers. (auth)

23796 PROPERTIES OF THE VLASOV PHASE IN PLASMA TURBULENCE THEORY. Skadron, G.; Jones, M.E. (Department of Physics, Drake University, Des Moines, Iowa 50311). Phys. Fluids 17: No. 2, 500-502 (Feb 1974).

While the Vlasov phase, $[X^v(t,t_0), V^v(t,t_0)]$, can be identified as a perturbed particle trajectory in the variable t_0, the time-reversed Vlasov phase may be identified as the phase space stream of test particles at the fixed time t_0 which emanates from [x,v]. (auth)

Kinetics (Experimental)

23797 (IAE-2275) EXPERIMENTAL STUDY ON A FLOW IN THE MAGNETOPLASMA COMPRESSOR. Berkov, V. I.; Vinogradova, A. K.; Kovrov, P. E.; Morozov, A. I.; Tokarev, L. G.; Proshin, M. A.; Shchepkin, G. Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 20p. (In Russian). INIS.

The results of the experimental study of the plasma flow in a magnetoplasma compressor were reported. The external form and the volt–amp characteristics, obtained from topograms of the electric and magnetic fields within the volume of the magnetoplasma compressor, were studied. The effect of the electrode geometry was examined. (tr-auth)

23798 (IPPJ-175) ANISOTROPY OF ELECTRON DISTRIBUTION FUNCTION OF AFTER-GLOW PLASMA GENERATED BY ELECTRON CYCLOTRON RESONANCE HEATING AND CONFINED IN MAGNETIC MIRROR FIELD. Yamamoto, N.; Aikawa, H.; Hatta, Y.; Ikegami, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1973. 10p. NTIS (US Sales Only).

Anisotropy of electron distribution function of afterglow plasma generated by electron cyclotron resonance heating and confined in a magnetic mirror field was studied with the use of a magnetic mirror probe method. It was found that the observed distribution indicates the characteristics of the loss-cone distribution function. (auth)

23799 IONISATION MECHANISM IN THE RELAXATION ZONE OF WEAKLY INSTATIONARY SHOCK WAVES IN ARGON AND KRYPTON. Meinhold, G.; Demmig, F.; Boetticher, W. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Plasmaphysik). Z. Naturforsch.; 29A: No. 4, 568-576(Apr 1974). (In German).

11 figs.; 2 tabs.; 18 refs.

The primary ionisation relaxation up to electron densities of $n_e = 4 \times 10^{13}$ cm^{-3} is investigated by means of 4 mm microwave interferometry. The values of the time dependent gas temperature T_s and gas density n_s behind the shock front are calculated using a gasdynamic model which strictly takes into account the nonstationarity of the flow. From the results, it is concluded that neither the familiar two-step process dominated by atom collisions nor the assumption of additional excitation processes by electron collisions can fully describe the observed ionization rates. There is evidence that both the ionization rates and the electron temperature are influenced by transitions between the first four excited states due to superelastic electron collisions. As a result the electron temperature may even exceed the gas temperature. (auth)

23800 INVESTIGATION OF THE AFTERGLOW IN HELIUM-XENON MIXTURES AT HIGH PRESSURES. Zinko, H.; Johansson, J. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Z. Naturforsch., A; 29: No. 4, 577-587(Apr 1974).

10 figs.; 25 refs.

The behavior of high pressure helium afterglows was measured by means of conductivity and light intensity decay measurements. The plasma was created in a pulsed discharge of typically 30 μsec length and then investigated by means of time resolved spectroscopy and probing pulse diagnostics under conditions which are of interest for noble gas afterglow MHD generators, i.e., a pressure range of 1–4 atm static pressure, the temperature varying from 600–970 K. A marked increase in plasma lifetime was found when xenon was seeded with a rate of 10^{-4} to 10^{-3} to helium. This effect is ascribed partly to the influence of Penning ionization and partly to the fact that slowly recombining atomic xenon ions dominate the recombination behavior at the lower xenon seed rates during the investigated time interval of 150 μsec. The pressure-dependent effective recombination coefficient is found to be $(0.95 + 1.95\ 10^{-3}\ Po)\ 10^{-6}$ cm^3 sec^{-1} for pure helium and $(0.2 + 5.1 \times 10^{-4}\ Po)\ 10^{-6}$ cm^3 sec^{-1} for a xenon seed rate of 3×10^{-4} (Po = reduced pressure in Torr). (GE)

23801 EXPERIMENTAL STUDY OF FORBIDDEN OPTICAL TRANSITIONS IN A DENSE, LASER-PRODUCED PLASMA. Hawryluk, R.J.; Bekefi, G.; George, E.V. (Department of Physics and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. A 10: No. 1, 265-277 (July 1974).

The intensities and line profiles of several forbidden optical transitions, together with their companion allowed lines were measured in a helium plasma having densities N ranging between $\sim 1 \times 10^{16}$ and $\sim 5 \times 10^{16}$ cm^{-3}. The plasma was produced by irradiating helium gas with light from a repetitively pulsed, high-power CO_2 laser. The time- and space-resolved spectra of three forbidden lines of He i were examined: the 2 ^{1}P–3 ^{1}P transition at 6632 Å, the 2 ^{3}P–4 ^{3}F transition at 4470 Å, and the 2 ^{3}P–4 ^{3}P transition at 4517 Å. The Abel-transformed line

shapes were compared with recent theories and, while some discrepancies exist, their magnitude is considerably less than has been reported hitherto. A series of tests was made from which it is concluded that the existing disagreements are not the result of measuring deficiencies or errors in data processing, and are probably due to some remaining inadequacies of the theoretical models. (auth)

23802 ELECTRICAL CONDUCTIVITY AND THE RADIATION ON AN ARGON PLASMA IN THE AFTERGLOW. Hugentobler, E.; Schneider, H. (Fribourg Univ. (Switzerland). Inst. de Physique). Z. Naturforsch., a; 29: No. 5, 678-686(May 1974). (In German). 7 figs.; 21 refs.

The electrical conductivity of an argon plasma in the afterglow has been measured by means of radiowave-diagnostics. The radiation of some ArI and ArII lines as well as the electron density are determined as a function of time. The relative population of the Ar lines (Boltzmann plot) are in agreement with the temperature as taken from Spitzer's formula using the measured conductivity within errors, except at the very early afterglow. The observed intensities of the ArI lines and the measured electron density indicate that LTE exists for the excited states. However, the ground-state appears to be strongly underpopulated. (orig.)

Kinetics (Theoretical)

Refer also to abstract 26326.

23803 (IAE-2276) THEORY OF FLOW IN STREAM CORE OF MAGNETOPLASMA COMPRESSOR. Morozov, A. I.; Brushlinskii, K. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 32p. (In Russian). INIS.

A theoretical analysis was made of the plasma flow in the stream core in a magnetoplasma compressor. The Hall effect and the final magnitude of the Ohm resistance were taken into consideration. (tr-auth)

23804 (JAERI-M-5462) EQUILIBRIUM CONFIGURATIONS OF A PLASMA COLUMN WITH EXTERNAL CURRENT-CARRYING CONDUCTORS. Maeda, H.; Shimomura, Y.; Kitsunezaki, A.; Yoshikawa, M. (Japan Atomic Energy Research Inst., Tokyo). Nov 1973. 7p. (In Japanese). NTIS (US Sales Only).

Equilibrium configurations were obtained analytically for a straight plasma column with a surface current in the magnetic field produced by external current-carrying conductors. The method of analysis is similar to that used by Namiot to derive equilibrium configurations of a plasma column placed between parallel conducting plates. (auth)

23805 PAIR-CORRELATION FUNCTIONS FOR PARTIALLY IONIZED HYDROGEN. Pokrant, M.A.; Broyles, A.A. (Department of Physics and Astronomy, University of Florida, Gainesville, Florida 32611); Dunn, T. Phys. Rev. A 10: No. 1, 379-392 (July 1974).

A method is presented for calculating the pair-correlation functions for a high-density quantum-mechanical plasma of protons and electrons. The Slater sum is approximated in the form of a classical Boltzmann factor with the Coulomb potentials replaced by effective potentials. The effective potentials contain the classical potential plus quantum corrections. The quantum effects may be separated into symmetry effects, diffraction effects, and coupling between the two. This method is exact at infinite temperatures and is tested here down to temperatures at which there is about 40% ionization. The pair-correlation functions are obtained from a Monte Carlo calculation. The fraction of electrons in the ground state of an atom is also calculated; an approximate formula for this fraction is $(1/2)[1-\mathrm{erf}(b\ \ln T/T_0)]$, where b and T_0 are simple fitted functions of the density. (auth)

23806 VISCOSITY-DOMINATED CONVECTIVE PLASMA DIFFUSION. Okuda, H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 17: No. 2, 375-377 (Feb 1974).

It is shown that, in addition to the classical ($D_\perp \sim B^{-2}$), plateau ($D_\perp \sim B^0$), and Bohm ($D_\perp \sim B^{-1}$) diffusions, there is a new region of diffusion between the classical and the plateau regions where the diffusion increases with increasing the magnetic field. In this region, the lifetime of the convective cells is determined by the ion collisional viscosity and, therefore, this region is important for a plasma with large ion mass. (auth)

23807 NONLINEAR SELF-SIMILAR BOUNDARY-VALUE PROBLEM FOR A DIVERGENT PLASMA FLOW. Wilhelm, H.E. (Department of Electrical Engineering, Colorado State University, Fort Collins, Colorado 80521). Phys. Fluids 17: No. 2, 360-368 (Feb 1974)

A similarity transformation is given, which reduces the partial, nonlinear differential equations describing a compressible, polytropic plasma flow across an azimuthal magnetic field in a duct with plane inclined walls to an ordinary nonlinear differential equation of second order. The latter is solved rigorously in terms of a hyperelliptic integral. The form of the plasma flow fields in pure outflows (diffuser) is discussed analytically in dependence of the Reynolds (R) and Hartmann (H) numbers and the polytropic coefficient (γ) for given duct angles θ_0. The realizable Mach numbers are shown to be eigenvalues of the nonlinear boundary-value problem, $M = M(R,H,\gamma,\theta_0)$. (auth)

23808 COMMENTS ON "REVERSE CURRENT INDUCED BY INJECTION OF A RELATIVISTIC ELECTRON BEAM INTO A PINCHED PLASMA". Poukey, J.W.; Toepfer, A.J. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Fluids 17: No. 2, 505-506 (Feb 1974).

We present calculations that tend to invalidate the assumptions of infinite plasma radius and neglect of the Hall effect that were made by Cox and Barnett. (AIP)

23809 SLOWING DOWN OF IONS BY ULTRAHIGH-DENSITY ELECTRON PLASMA. Dar, A.; Grunzweig-Genossar, J.; Peres, A.; Revzen, M.; Ron, A. (Department of Physics, Technion-Israel Institute of Technology, Haifa, Israel). Phys. Rev. Lett. 32: No. 23, 1299-1301 (10 June 1974).

The slowing down of ions by a degenerate electron plasma is calculated by means of the random-phase approximation. It is shown that high compressions greatly reduce the ability of electrons to slow down ions. These results indicate that nuclear burning of a DT plasma can proceed as a chain reaction, even at low temperature, at densities about 10^3 times the solid density. (auth)

23810 THE COLUMN OF A DC ARC BURNING IN A METAL HALIDE ATMOSPHERE. Fischer, E. (Philips Forschungslaboratorium Aachen GmbH, 5100 Aachen, Postfach 1980, Weisshausstrasse, Germany). J. Appl. Phys. 45: No. 8, 3365-3373 (Aug 1974).

Starting from energy and mass balance (diffusion equation), temperature distributions and plasma compositions are calculated for metal halide discharges in closed cylindrical vessels with and without mercury (buffer gas). Special interest is given to arcs in tin halide atmospheres. While for pure tin halide discharge radiation can be neglected, the energy transfer by radiation must be considered in discharges containing larger amounts of mercury. The results obtained for electrical data as well as for thermal data of Sn-I arcs are in reasonable agreement with the experiments. (auth)

23811 EXCHANGE EFFECTS IN QUANTUM KINETIC EQUATIONS FOR NONIDEAL GAS AND NONIDEAL PLASMA. Klimontovich, Yu. L.; Kraeft, W. D. (Moscow State Univ.). Teor. Mat. Fiz.; 19: No. 3, 364-370(Jun 1974). (In Russian).

It is shown that the exchange effects are always of importance in calculations of the nondissipative characteristics, because in this case the interaction of particles at small distances is significant even in plasma. For gases, the calculation is performed in the approximation of pair collisions. In the plasma case, in addition to this approximation, the average dynamic polarization of the plasma is also taken into account, which guarantees the convergence of the integrals at large distances. (auth)

23812 THEORY OF TURBULENCE IN HYDRODYNAMICS AND PLASMA. Kadomtsev, B. B.; Kontorovich, V. M. (Inst. of Radiophysics and Electronics, Kiev). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 4, 511-540(1974). (In Russian).

The theory of weak turbulences and turbulences of plasmas and incompressible fluids is analyzed. In the first section distributions of the Kolomogorov type—with steady flow according to the turbulence spectrum—are discussed using as an example waves on the surface of the fluids. These distributions can be found not only from dimensional considerations from precise solutions of kinetic equations which are the essential results of the theory of weak turbulences. In the second part the discussion is devoted to the turbulences in very complex cases of plasma where interactions of the wave with particles exist. Collisionless relaxations, connected with non-wave functions of the self-consistent field, are discussed. Mixing in the phase space can occur very rapidly because of the existence of long-lived "macroparticles"—bunches formed by the original distribution. From analogies between the movement of plasmas and the flow of incompressible fluids it can be concluded that collisionless relaxation occurs in the usual turbulences. (tr-auth)

23813 MAGNETOCONDUCTIVITY TENSOR OF A TWO DIMENSIONAL PLASMA IN QUANTIZING MAGNETIC FIELD. Morgenstern Horing, N. J.; Orman, M.; Yildiz, M. (Stevens Inst. of Tech., Hoboken, N. J. (USA). Dept. of Physics). Phys. Lett., A; 48: No. 1, 7-8(20 May 1974).

The nonlocal dynamic magnetoconductivity tensor σ_j^i of a two dimensional plasma subject to Landau quantization is obtained using the R.P.A.: σ_j^i is presented here in closed form and also in a "Landau series" expansion valid for all magnetic fields. (auth)

23814 ANOMALOUS VISCOSITY DUE TO ELECTROSTATIC TURBULENCE. Gary, S. P.; Schmidt, J. (College of William

and Mary, Williamsburg, Va. (USA). Dept. of Physics). Phys. Lett., A; 48: No. 1, 23-24(20 May 1974).

In some plasma experiments, there is substantial indirect evidence that externally induced fields penetrate the plasma on time scales much more rapid than those of classical diffusion. Several authors have suggested that these results may be described by an anomalous viscosity μ^* due to superthermal fluctuations in the plasma. To calculate μ^*, a stochastic model is considered in which given electrostatic fluctuations produce small-angle, random scatterings of the electrons. The expression is compared with a similar result for anomalous resistivity. (auth)

23815 FREE-BOUNDARY MHD-EQUILIBRIA IN AXISYMMETRIC TORI. Suzuki, Y. (Nagoya Univ., Japan). Nucl. Fusion; 14: No. 3, 345-352(Jun 1974).

A method of numerical computation is presented in order to obtain equilibrium configurations in axisymmetric tori with ideally conductive shells of arbitrary cross-sections and/or with control-field coils. In this method, an artificial function $S(\psi)$ is introduced, which makes it possible to combine the equilibrium equations in the plasma and the equation for the vacuum into one equation. The alternating-direction implicit method coupled with the Marder–Weitzner iteration scheme is used to solve the combined equilibrium equation under the boundary condition given on the shell. The continuity conditions at the plasma-vacuum interface are automatically satisfied in the solutions obtained. Some results of the computation are illustrated for cases where the shell shapes are of circular, square, rectangular and finger-ring type, respectively, and for a case with a ring coil placed inside the square shell. (auth)

23816 ANALYTIC STUDY OF MHD-EQUILIBRIA OF PLASMAS WITH NON-CIRCULAR CROSS-SECTIONS. Becker, G. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 14: No. 3, 319-321(Jun 1974).

MHD-equilibria of plasmas with various half-axis ratios a/b are studied by conformal mapping in a sharp-boundary model with surface currents (upper limit for compression ratio κ_b) and a conducting wall. Plasma surface and wall are coordinate surfaces. First, an exact equilibrium solution for a semi-infinite plasma slab between parallel walls is derived ($a/b \to \infty$). It is found that κ_b is only 2, and that the plasma end is almost semi-circular in shape. Then a class of mapping functions is determined for various a/b that yields sufficiently accurate equilibria and flux lines in the vacuum field region (computing time of only a few seconds). The asymptotic value ($a/b \to \infty$) of the κ_b-versus-a/b curve is the semi-infinite-slab result. (auth)

23817 STABILITY OF AN AXIALLY SYMMETRIC ROTATING PLASMA. Gutkin, T. I.; Tsypin, V. S.; Boleslavskaya, G. I. (Physical-Technical Inst., Sukhumi, USSR). Nucl. Fusion; 14: No. 3, 313-318(Jun 1974).

The stability of a cold axially symmetric rotating plasma against axially symmetric perturbations was studied. It is demonstrated that a plasma of this kind can only be aperiodically unstable. A plasma with a rotation frequency Ω that is much smaller than the ratio of the mean Alfvén velocity $\bar{v}_A$ to the plasma radius a, and with a sufficiently smooth equilibrium parameter profile is unstable with negligibly small growth rates (much less than the rotation frequency Ω). At high rotation frequencies Ω ($\Omega \sim \bar{v}_A/a$) the growth rate for the plasma instability γ can be made fairly small ($\gamma \ll \Omega$) by suitably selecting the radial dependence of the equilibrium parameters. (auth)

23818 GENERALIZATION OF THE METHODS OF BOGOLYUBOV AND MAYER FOR THE CASE OF DARWIN'S LAGRANGIAN WITH VELOCITY: DEPENDENT PAIR INTERACTIONS. Trubnikov, B. A.; Kosachev, V. V. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 14: No. 3, 435-438(Jun 1974).

Bogolyubov's method of treating gas kinetics and Mayer's thermodynamic method are suitable for systems which can be described by a Hamiltonian with pair particle interactions. An interesting situation arises if one considers the relativistic effects in a charged-particle system which can be described accurately to within terms of the order of $(v/c)^2$ by the well-known Darwin's Lagrangian. It is shown that the weakly relativistic effects in a plasma due to retardation and magnetic (Biot–Savart) interactions of particles are described satisfactorily by Darwin's Lagrangian but not by the simplified Hamiltonian. By some generalization of the methods of Mayer and Bogolyubov for the case of pair interactions in the Lagrangian one can formulate the thermodynamics and kinetics of such a plasma. (MOW)

Production

Refer also to abstracts 23766 and 23787.

23819 (IPP-IV-65) ESTIMATIONS FOR A LASER-PLASMA SOURCE. Buechl, K. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Dec 1973. 78p. (In German). Dep. NTIS (U. S. Sales Only) $7.00.

Estimations are described for a plasma source which can be used for filling of stellarators and other magnetic confinement devices with plasma. The estimations cover the plasma production by laser, the production of hydrogen pellets from a jet, the transfer of the pellet into high vacuum, charging of the pellet into the focus of a laser. (auth)

23820 PRODUCTION OF A DENSE ELECTRON CLOUD IN THE MAGNETIC FIELD IN AN OPEN TRAP. Kolyada, Y.E.; Kornilov, E.A.; Fainberg, Y.B. Sov. Phys.–Tech. Phys. 18: No. 10, 1364-1365 (Apr 1974).

An experimental study is made of the possibility of producing an elongated high-density electron cloud in the time-increasing magnetic field of an open trap. It is shown that by using the induction method of accelerating electrons in a magnetic field, a long-lived nonneutral electron cloud with a deep potential well can be produced. Using a 5 keV 3 A beam and a magnetic field rising to 116.10^3 G in 4.10^{-4} sec we obtain an electron cloud 50 cm long with an electron density 2.10^{11} cm^{-3} in the axial region and a 200 kV potential well. The cloud lifetime is 250 μsec. The value 200 kV can be exceeded. (auth)

23821 REFLECTIVITY STUDIES OF LASER-PRODUCED PLASMAS OF VARIABLE DENSITY. Gruhl, T.; Puell, H.; Kaiser, W. (Physik-Department der Technischen Universität München, München, Germany). Appl. Phys. Lett. 25: No. 3, 135-137 (1 Aug 1974).

Light reflected from a laser-produced plasma was measured as a function of plasma density. Light pulses of a Nd-glass laser (100-psec duration and 10^{14}-W/cm^2 intensity) were focused on a high-pressure gas jet as a target. A distinct reflectivity maximum of 0.3 was observed for helium at a density value 30% below the critical density. The results are interpreted in terms of stimulated Brillouin scattering. (auth)

23822 MICROWAVE POWER ABSORPTION NEAR THE SECOND HARMONIC OF ELECTRON CYCLOTRON RESONANCE. Beerwald, H.; Boehm, G.; Kraemer, M. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik 2). Z. Phys.; 268: No. 2, 165-170(Jun 1974). (In German).

8 figs.; 9 refs.

In plasmas produced by microwave power, the electron density displays a dependence on the magnetic field strength obviously asymmetric with respect to the harmonics of the electron cyclotron frequency. In regions of the magnetic field strength just above the harmonics there are extremely high values of electron density, the density values dropping sharply off towards the other wing of the harmonics. Absorption experiments near the second harmonic at low microwave power, the plasma being produced by different means, reveal a resonant absorption structure in the magnetic field region above the harmonic. This can be attributed to excitation of geometrical eigenmodes of electrostatic waves propagating perpendicular to the magnetic field (Bernstein waves). (orig.)

23823 SPONTANEOUS MAGNETIZATION OF ELECTRONIC THERMAL CONDUCTIVITY IN A LASER PLASMA. Bol'shov, L. A.; Dreizin, Yu. A.; Dykhne, A. M. JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 168-170(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 288-291(5 Mar 1974).

The magnetization of the electronic thermal conductivity in a laser plasma by the spontaneous magnetic fields resulting from thermoelectric effects in an inhomogeneous plasma was studied. A system of equations describing the evolution of the magnetic fields and of the electron temperatures was derived. The increments of the magnetothermal instability are obtained. The role of magnetothermal effects in experiments with laser plasma is discussed. (auth)

23824 STUDY OF THE CHARACTERISTICS OF THE ION BEAM EXTRACTED FROM AN RF DISCHARGE IN HYDROGEN UNDER CONDITIONS OF RESONANCE. Grolleau, B. (Laboratoire de Physique Corpusculaire, Institut de Physique, 44037 Nantes, France). J. Appl. Phys. 45: No. 8, 3385-3393 (Aug 1974).

The characteristics of an ion beam issued from a hydrogen plasma have been studied. This plasma is obtained by means of a high-frequency discharge set under conditions of resonance. This resonance is obtained by inductively exciting the discharge in a transverse static magnetic field (perpendicular to the axis of the vessel). The resonance, of which we give the characteristics, permits a considerable increase in the ionization degree, and is therefore of interest as regards to ion sources. The beam of particles extracted from this discharge in resonance is studied by means of a magnetic analyzer. The energy distributions of the various ions consist of two parts. A comparative analysis of the characteristics of the beam, with and without resonance, shows that this resonance improves the properties of

the system. In particular, for the H^+_1 ion, the energy dispersion is reduced to 25 eV and its proportion in the beam reaches 85%. This resonance proves to be a convenient and very simple means to obtain an H^+_1 ion beam. (auth)

Stability

Refer also to abstract 23765.

23825 (COO-2081-13) EVALUATION OF ION TEMPERATURE AND DENSITY GRADIENTS AND LOSS-CONE FILLING ON THE DRIFT-CONE INSTABILITY. Catto, P. J. (Colorado Univ., Boulder (USA)). Sep 1973. Contract AT(11-1)-2081. 8p. Dep. NTIS $4.00.

The effects of $\Delta T_\perp$, $\Delta T_\parallel$, and ion density gradients are evaluated for the simplest model of the drift-cone instability in mirror machines. It is shown that ion gradients are important in this model in a large region of wave vector space, but in this region the linear growth rate is always small compared to the maximum rate. Ion loss-cone filling effects are also calculated and shown to be unimportant for radial gradients of current mirror devices. (auth)

23826 (COO-2081-14) MAGNETIC SHEAR STABILIZATION AND FINITE β EFFECTS ON THE DRIFT-CONE MODE. Catto, P. J. (Colorado Univ., Boulder (USA)). Aug 1973. Contract AT(11-1)-2081. 16p. Dep. NTIS $4.00.

The effects of magnetic shear and finite beta are calculated for a simple model of the drift-cone instability in mirror machines. Finite beta effects are found to be stabilizing and can be important in the high beta operational regime of 2X-II. Magnetic shear reduces growth rates also, but for present machine parameters, it does not substantially affect maximum growth rates. (auth)

23827 (UCID-15591) BOUNDARY CONDITIONS FOR CONVECTIVE WAVE INSTABILITIES IN MIRROR MACHINES. Berk, H. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Oct 1969. 12p. Dep. NTIS $4.00.

Wave behavior at the ends of a mirror machine depends critically on the shape of the electron distribution function. It has been shown by Taylor that if at the energy of maximum containment the distribution vanishes discontinuously then waves reflect. However, it is shown here that waves damp without reflecting if the distribution function vanishes linearly at the energy of maximum containment. (auth)

23828 A HOT-CATHODE DISCHARGE IN CROSSED FIELDS. Farenik, V.I.; Vlasov, V.V.; Rozhkov, A.M.; Krivonos, M.G.; Sosipatrov, M.V. (A. M.,Gor'kii Khar'kov State University). Sov. Phys.-Tech. Phys. 18: No. 10, 1299-1302 (Apr 1974).

The main experimental results of an investigation of the characteristics of a hot-cathode discharge in crossed fields at a low initial pressure $P < 10^{-4}$ torr are presented. The fact that the plasma is unneutralized ($n_e > n_i$) at $P < 10^{-4}$ torr with a magnetic field $H > H_{cr}$ is noted; a transition to another mode of operation occurs when $p > 10^{-4}$ torr. Measurements of the potentials along the axis and along a radius of an experimental device indicate the presence of a virtual cathode on the axis and significant inhomogeneities of the plasma along the radius of the diode. The radial profiles of the electron density and temperature are also inhomogeneous. Oscillations in the anode circuit are observed; oscillations of the probe current evidently due to drift instabilities in the inhomogenoeus plasma are also observed. (auth)

23829 THEORY OF PARAMETRIC INSTABILITIES. Buts, V.A. Sov. Phys.-Tech. Phys. 18: No. 10, 1382-1383 (Apr 1974).

It is shown that in a system with more than two characteristic oscillations several parametric resonance conditions can be satisfied simultaneously. The presence of an extra resonance leads to an increase in the parametric instability growth rates and to new instabilities. (auth)

23830 TWO-DIMENSIONAL STUDY OF ELECTRON-ION STREAMING INSTABILITIES. Lampe, M.; Haber, I.; Orens, J.H.; Boris, J.P. (Naval Research Laboratory, Washington, D. C. 20375). Phys. Fluids 17: No. 2, 428-439 (Feb 1974).

A two-dimensional study is presented, based on computer simulation, of strong electron-ion streaming instabilities induced by counterstreaming ion beams, for initially cold electrons ($v_e \ll v_d$). Wave growth initially agrees well with linear theory. Higher harmonics appear later, in good agreement with mode coupling theory. The wave spectrum, initially very broad perpendicular to the streaming direction, narrows as the electrons heat and the waves saturate, in accordance with quasilinear theory. Electron heating is explained by nonresonant quasilinear diffusion at early times, and by resonant turbulent diffusion at later times. In contrast to previous one-dimensional studies, it is found that electron heating continues well after wave saturation and after $v_e > v_d$. However, the heating rate at late times is somewhat reduced by partial plateau formation in the electron velocity distribution. Coherent electron trapping is not seen, as it is in the one-dimensional situation, but coherent ion trapping does occur and dominates the wave dynamics at late times, terminating wave growth on the time scale studied. (auth)

23831 KINK INSTABILITIES IN A HIGH-β TOKAMAK WITH ELLIPTIC CROSS SECTION. Freidberg, J.P.; Haas, F.A. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Fluids 17: No. 2, 440-446 (Feb 1974).

A toroidal, elliptic cross-section, sharp-boundary model of a high-pressure tokamak with currents confined to the surface, is tested for stability against kink modes. It is shown that the optimum configuration corresponds to a vertical ellipse in which the ratio of the major to minor axes is 2.2. For this case, the maximum critical β for stability against kink modes is $\beta = 0.37a/R$. For $\beta > 0.37a/R$ the model is unstable for all values of the safety factor above and below the Kruskal-Shafranov limit. (auth)

23832 KINK INSTABILITIES IN THE BELT PINCH. Marder, B.M. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Fluids 17: No. 2, 447-451 (Feb 1974).

The stability with respect to kink modes of a high β straight screw pinch with elliptical cross section is examined using sharp boundary theory. No restriction is placed on the ellipticity or β. It is found that the critical q needed for stability is no longer unity but is a strongly increasing function of ellipticity. There are indications that large ellipticity in toroidal systems is too strongly destabilizing to allow such equilibria to be useful; however, small ellipticity may be useful for achieving higher β. (auth)

23833 MAGNETOHYDRODYNAMIC STABILITY THEORY WITH CLOSED MAGNETIC FIELD LINES. Spies, G.O. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). Phys. Fluids 17: No. 2, 400-408 (Feb 1974).

Localized (i.e., Suydam-type) displacements are considered in the energy principle for arbitrary closed-line equilibria (constant rational rotational number). The resulting necessary stability condition is more pessimistic than any previously known necessary conditions for closed-line equilibria, but more optimistic than the low-shear limit of the corresponding condition for equilibria with shear. A discussion is given of the presently available stability conditions for general toroidal equilibria with or without shear and of their interrelations. (auth)

23834 NONLINEAR THEORY OF ABSOLUTE WHISTLER INSTABILITIES IN FINITE β PLASMAS. Jamin, E.; Parkinson, D.; Rogister, A.; Bornatici, M. (European Space Research Institute of the European Space Research Organisation, Frascati, Rome, Italy). Phys. Fluids 17: No. 2, 419-427 (Feb 1974).

The nonlinear evolution and stabilization of absolute whistler instabilities driven by electron pressure anisotropy and propagating obliquely to the external magnetic field in finite β plasmas are investigated without introducing the assumption of random phases. Both in the firehose and the mirror instability regimes the pressure anisotropy relaxes quasilinearly toward a more stable state. The nonlinear wave equation has also been obtained. By choosing the parameters in such a way that the plasma is sufficiently close to linear marginal stability, it has been possible to show both numerically and analytically that the (firehose) instability stabilizes nonlinearly at sufficiently low levels of excitation. The fluctuation level does not asymptotically approach a constant value, but oscillates in time, the maximum amplitude being proportional to the linear growth rate. Also, close to marginal stability, finite Larmor radius effects can play a significant role even in the limit $kR \ll 1$. It is found that finite Larmor radius effects are stabilizing if $\tan^2\alpha > 4\beta_\parallel/\beta_\perp$, where α is the angle between the direction of wave propagation and the direction of the background magnetic field and $\beta_{\parallel(\perp)}$ is the ratio of perallel (perpendicular) kinetic to magnetic pressure. (auth)

23835 DRIFTING OSCILLATING TWO-STREAM INSTABILITY. Johnston, G.L. (Department of Physics and Astronomy, California State College, Sonoma, Rohnert Park, California 94928). Phys. Fluids 17: No. 2, 416-418 (Feb 1974).

The theory of parametric excitation of plasma waves is applied to a plasma in which there is a static drift between electrons and ions. For appropriate values of drift speed and elevated electron-ion temperature ratio, there exists a solution of the dispersion relation and a threshold for instability at a frequency which is close to zero in the electron frame. This instability occurs for pump frequencies which are slightly below the Bohm-Gross frequency. It has some similarities to the oscillating two-stream instability in a plasma in which there is no static drift. An approximate analytic solution of the dispersion relation in the neighborhood of zero frequency is obtained. (auth)

23836 FORMATION OF NONTHERMAL ION TAILS IN THE ION ACOUSTIC INSTABILITY. Manheimer, W.M. (Naval Research Laboratory, Washington, D. C. 20375); Flynn, R.W. Phys. Fluids 17: No. 2, 409-415 (Feb 1974).

The rate at which ions are transported from the body to the nonthermal tail of the distribution function during the nonlinear stage of the ion acoustic instability is calculated self-consistently. The nonlinear stage is characterized by a very small growth rate and a tail whose population increases slowly in time. The calculation is done by conserving the energy and momentum of ions, electrons, and electrostatic fields in the linear and nonlinear regime. These two conservation laws give rise to two equations for growth rate and phase velocity. (auth)

23837 PROBABILITY DISTRIBUTION FOR FOURIER COMPONENTS OF THE ELECTRIC FIELD IN WEAK PLASMA TURBULENCE. O'Neil, T.M. (Department of Physics, University of California, San Diego, La Jolla, California 92037). Phys. Rev. Lett. 33: No. 2, 73-75 (8 July 1974).

Probability distributions for Fourier components of the electric field, including joint distribution for different Fourier components and multiple-time distributions for the same component, are determined using two assumptions within the spirit of weak-turbulence theory. The statistical framework is then applied to the special case where the turbulence is dominated by the wave-particle interaction (i.e., the quasilinear case). (auth)

23838 INSTABILITIES IN A BEAM–PLASMA SYSTEM OF ZONAL MAGNETIC FIELD. Sinman, S.; Sinman, A. (Ankara Nuclear Research Center). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 2, 57-88(Jun 1974).

In the interaction theory of beam–plasma systems, continuity of the magnetic field is not prerequisite in the definition of especially the transversal dielectric tensor. The presence of a homogeneous magnetic field effect in one zone suffices. On the other hand, the longitudinal dielectric tensor is not dependent upon the intensity of the magnetic field. This system consisted of a double-aperture electrostatic lens and a magnetron-injection electron gun. In this inhomogeneous system the magnetic field is zonal. The longitudinal energy component of the electron beam is 1.5 keV maximum. Electron densities of 10^7 cm^{-3} to 10^{10} cm^{-3} were obtained in the beam–plasma discharge produced in hydrogen at 2×10^{-4} to 8×10^{-4} torr. Although contingent upon experimental conditions, the beam density was increased up to 5×10^8 cm^{-3}. Among the interesting observations experimentally determined were ω_2 interaction near the total plasma frequency, ω_4 interaction under $\omega_{po} > \omega_{ce}$ condition, trapping of the beam with two-stream instability, etc. An analysis of the hot electron plasma (up to 100 eV) was carried out, using a computer, and the role of warm ions (up to 2 eV) in the interaction was also pointed out. The experimental results were discussed in view of the interaction theory, and conditions were determined for the approach to interaction criteria in a beam-plasma system. (auth)

23839 PARAMETRIC EXCITATION OF OSCILLATIONS IN SYSTEMS WITH AN ELECTRON BEAM. Buts, V.A.; Ismailov, A.N. Sov. Phys.–Tech. Phys. 18: No. 9, 1267-1268 (Mar 1974).

It is shown that waves excited in a system by an electron beam through one of the cooperative instability mechanisms then parametrically excite a broad spectrum of longitudinal beam oscillations. The parametric instability of waves excited through two-stream and cyclotron instabilities and the instability of longitudinal waves excited in a beam by velocity modulation at entry are shown experimentally. (auth)

23840 CONTRIBUTION TO THE THEORY OF THE MAGNETIC INSTABILITY OF A LASER PLASMA. Al'terkop, B. A.; Mishin, E. V.; Rukhadze, A. A. JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 170-171(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 291-294(5 Mar 1974).

It is shown that correct allowance for thermal diffusion changes the character of the excitation of the magnetic fields in a one-dimensionally inhomogeneous plasma; namely, the instability turns out to be convective and not absolute, while the magnitude of the excited fields is determined entirely by the density and temperature profiles of the plasma. (auth)

23841 DYNAMIC TRANSMISSION OF INSTABILITY REGIONS IN A CYLINDRICAL PLASMA COLUMN WITH FEEDBACK. Ladikov, Yu. P.; Potapenko, L. S. (Inst. of Cybernetics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 6, 907-912(Jun 1974). (In Russian).

The possibility of transmission in the regime of the discharge current is examined in the presence of an automatic control system. It is shown when the amplification factor is maintained with a necessary precision, the perturbation amplitude rapidly (for 1 msec) decreases to a permissible level. (auth)

23842 DIRECT MAPPING OF SPACE STRUCTURE OF A ROTATIONAL INSTABILITY IN LABORATORY PLASMAS. Zakrzewski, Z. (Inst. of Fluid Flow Machines, Danzig); Kopiczynski, T.; Rusakiewicz, R.; Stirand, O. Czech. J. Phys.; 24: No. 8, 885-890(1974).

The investigation of the radial ion density profile in the magnetoplasma is described. The method uses the Langmuir probe which is movable along the tube radius. The radial position of this probe destines the vertical beam position on the CRT. The oscilloscope time base is synchronized with the frequency of the instability and is proportional to the azimuthal position. (auth)

23843 STABILITY OF A FINITE-β INHOMOGENEOUS PLASMA IN A SHEARED MAGNETIC FIELD. Catto, P. J.; El Nadi, A. M.; Liu, C. S.; Rosenbluth, M. N. (Inst. for Advanced Study, Princeton, NJ). Nucl. Fusion; 14: No. 3, 405-418(Jun 1974).

In a plasma immersed in a sheared magnetic field of shear length L_s and having a density gradient of scale length L_n, finite β (plasma pressure/magnetic pressure) results in an additional stabilizing influence over and above that due to magnetic shear. Employing a full electromagnetic treatment, these finite-β corrections are evaluated for $\beta k^2 a_i^2 L_s^2 / L_n^2 \ll 1$, where a_i is the ion gyration radius and k is the wave vector perpendicular to both the direction of the density gradient and the unsheared component of the magnetic field. For the parameter ranges least stabilized by shear, the dominant finite-β-stabilization effect occurs within the region about the rational surface where the phase velocity is larger than the Alfvén speed. As β increases toward $L_n^2/k^2 a_i^2 L_s^2$ or $(ka_i m/M)^{\frac{1}{3}} [\ln(ML_n/m|L_s|)]^{\frac{1}{3}}$, this finite-$\beta$ correction must be retained, where m/M = electron mass/ion mass. (auth)

Thermonuclear Engineering and Equipment

23844 (AD-775992/1) EXPLOSIVE ELECTRON EMISSION AND THE CHARACTERISTICS OF HIGH-CURRENT ELECTRON FLOW. Final Report, October 1970–January 1973. Parker, R. K. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Feb 1974. 298p. (AFWL-TR-73-92). NTIS $6.75.

Within the past several years, an increasing effort has been concentrated on the development of high-current, relativistic electron beams. Initially, this effort was impeded by limitations in the high-voltage and pulsed-power technology required to develop pulsed, high-power electron accelerators. These technologies have been developed to a level where powers on the order of 10^{13} Watts are now available for time durations of approximately 100 nanoseconds. Emphasis has more recently been centered on controlling and concentrating these beams. The initial behavior of the beam within the diode region of the accelerator becomes an extremely critical element. The high-current, cold-cathode diode which is distinguished by nonself-convergent electron flow has been studied to define operative electron emission mechanisms, to determine the dominant plasma phenomena within the interelectrode volume, to classify the modes of electron flow, and to verify the Friedlander beam convergence criterion. (auth)

23845 (AED-CONF-74-085-006) TECHNOLOGICAL PROBLEMS OF THE FUSION REACTOR. Darvas, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). 1974. 13p. (In German). INIS.

From spring meeting of the Deutsche Physikalische Gesellschaft e.V., its expert committees on: atomic physics, pulse physics, molecular physics, plasma physics; Stuttgart, F. R. Germany (4 Mar 1974).

24 figs. With abstract.

This is a comprehensive review of the technological problems encountered in the development of the fusion reactor. After a brief explanation of the basic principles and features of a fusion reactor, the breeding of tritium and tritium recycling, energy extraction through blanket cooling, material problems (especially thermal stresses and the effects of irradiation), as well as problems of fuel supply and removal and the difficulties associated with the control and prevention of impurities and the generation of the required magnetic fields are discussed. (GE)

23846 (COO-3528-1) EXPERIMENTAL INVESTIGATION OF CUSPED CONTAINMENT GEOMETRIES: CHALICE. Final Report on Project Chalice. Yevick, G. (Stevens Inst. of Tech., Hoboken, N. J. (USA)). 1972. Contract AT(11-1)-2320. 45p. Dep. NTIS $5.25.

This final report on Project Chalice is an updated version of the "Historical Survey of Project Chalice" which was published in 1967. The project was terminated in 1971, and the final version presented here is tempered by the passage of time. The lessons learned in this project are summarized at the very end. (auth)

23847 (JAERI-M-5502) CONCEPTUAL DESIGN OF A GAS COOLED TOKAMAK REACTOR. Sako, K.; Ohta, M.; Seki, Y.; Yamato, H.; Hiraoka, T. (Japan Atomic Energy Research Inst., Tokyo). Dec 1973. 17p. NTIS (US Sales Only).

A conceptual design of a helium-cooled tokamak reactor was carried out. Core plasma, reactor structure, blanket neutronics, and material of the reactor are evaluated. The main design parameters of the fusion reactor are as follows: reactor output 2000 MW(t), first wall loading 2 MW/m^2, plasma major/minor radius 10/2m, average toroidal magnetic field 60 kG, and reactor inlet/outlet coolant temperature 400/600°C. Li_2O pebble and Incoloy 800 are used for the blanket fertile material and the first wall material, respectively. (auth)

23848 (ORNL-4966, pp 62-67) SUPPORT FOR CONTROLLED THERMONUCLEAR PROGRAM. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

23849 (RL-74-076) FORTRAN PROGRAMS FOR 3 SADDLE WOUND DIPOLE MAGNETS, FOR A TOKAMAK D-MAGNET AND FOR THE GEOMETRY OF THE CONSTANT PERIMETER END. Rosten, H. I. (Science Research Council, Chilton (UK). Rutherford Lab.). May 1974. 20p. Dep. NTIS (U. S. Sales Only) $4.00.

Programs are given for the field/field integral to a given accuracy for the following current blocks: (1) helical end racetrack ("pole" or "dipole"); (2) constant perimeter end racetrack ("pole" or "dipole"; fine or coarse models); (3) the D-magnet for a tokamak fusion device. Programs are also given for the geometry of the constant perimeter end: (1) length of wire in the end, and (2) best value of cutting tool angle for constant perimeter condition. (auth)

23850 (UCID-15508) UNSTABLE BEAM BLOWUP IN THE ALICE BEAM LINE. Hall, L. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jul 1969. 5p. Dep. NTIS $4.00.

The reason for blowup of the neutral beam line in the Alice experiment is discussed. It is shown that the blow-up occurs as a result of an electrostatic instability which can be identified as the interaction between the plasma oscillations of the beam ions and the cyclotron motion of the background (cold) plasma electrons. (MOW)

23851 (UCRL-75443) NEW APPROACHES TO CTR: GENERAL RELATIVISTIC POWER PLANTS. Wood, L.; Weaver, T.; Nuckolls, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Mar 1974. 17p. (CONF-740316-6). Dep. NTIS $4.00.

From conference on electrostatic and electromagnetic confinement of plasmas and the phenomenology of relativistic electron beams; New York, New York, USA (4 Mar 1974).

Power generation involving gravitational initiation and confinement of fusion detonation events is discussed. The prospects for reproducing on vastly smaller scales the explosions of stars themselves for powering human civilization are discussed. It is recognized that gravitational CTR may appear to be enormously more difficult in a technological sense than the challenging program of inertial fusion via laser-energized implosion. Some possible means by which these difficulties may be overcome are also discussed. (auth)

23852 THERMONUCLEAR BURN CHARACTERISTICS OF COMPRESSED DEUTERIUM-TRITIUM MICROSPHERES. Fraley, G.S.; Linnebur, E.J.; Mason, R.J.; Morse, R.L. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Fluids 17: No. 2, 474-489 (Feb 1974).

The phenomenology of thermonuclear burn in deuterium-tritium microspheres at high densities is described, and numerical results characterizing the burn for a broad range of initial conditions are given. The fractional burnup, bootstrap-heating, and depletion of the DT fuel, its expansive disassembly, and thermonuclear ignition by propagating burn from central hot spots in the microspheres are discussed. Extensive numerical results from a 3-T Lagrangian simulation code are presented. The yields Y_0 from uniform 10, 1, and 0.1 μg microspheres with densities $\rho = 1$ to 4×10^4 g/cm^3 and temperatures $T_e = T_i = 1.8$ to 100 keV are given. It is shown that $Y_0 \sim \rho R$, $\rho R < 0.3$ (R is the microsphere radius) or, equivalently, $Y_0 \sim \rho^{2/3}$ for spheres of fixed mass m. The gain-factor $G_0 \equiv Y_0/mI_0$ (I_0 is the internal energy) is shown to measure burn efficiency in uniform microspheres. More than a four-fold increment in the gain factor is shown to derive from apportionment of the internal energy in a central hot spot. The limiting effects of electron degeneracy on the gain factor are outlined. As a guideline, the experimental observation of 10^{13} neutrons/kJ of input laser energy is established as proof of good absorption; 10^{15}/kJ will imply yields exceeding break even. (auth)

23853 FAST POWER "CROWBAR" SYSTEM USING A CURRENT TRANSFORMER WITH EXTREMELY LOW LEAKAGE INDUCTANCE. Kitagawa, S.; Hirano, K. (Institute of Plasma Physics, Nagoya University, Nagoya, Japan). Rev. Sci. Instrum. 45: No. 7, 962-963 (July 1974).

A power crowbar system for fast θ-pinch experiments is operated successfully. A current transformer with extremely low leakage inductance is used to reduce the effective impedance of series capacitor system. The leakage inductance of the transformer is reduced to 2 nH by employing a special arrangement of windings. It is demonstrated that a current of 40 kA, the rise time of which is 4 μsec, is maintained for 500 μsec. (auth)

23854 TECHNOLOGY INDEX FOR PLASMA PHYSICS RESEARCH AND FUSION REACTORS. Volume 8, No. 7, 1974. Bibliography, Author Index, Subject Index, Appendix. Leopoldshaften, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 39p.

23855 PLASMA PHYSICS INDEX. Volume 9, No. 7, 1974. Bibliography, Author Index, Subject Index. Leopoldshafen; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 185p.

23856 DESIGN CONSIDERATIONS FOR A SHALLOW-WELL MIRROR EXPERIMENT. Crume, E. C.; Haste, G. R.; Lazar, N. H. (Oak Ridge National Lab., TN). Nucl. Fusion; 14: No. 3, 323-326 (Jun 1974).

The design of a "shallow-well" mirror device suitable for production and confinement of an electron cyclotron heated plasma is described. The well is shallow in that the radial variation of the magnetic field strength is ~5%, with a 2:1 axial mirror ratio. The design uses elliptical mirror coils, circular central coils, and straight, skewed quadrupole coils. Coil positions and currents are optimized by finding those combinations which result in the largest axial and radial regions of favorable particle drift. The particle drift direction is determined from the radial gradient of the longitudinal invariant J. The limits on adiabaticity are estimated from the magnetic field gradients. These considerations show that a plasma would be confined with an axial extent of ~160 cm, a radial extent of ~20 cm, and with an adiabatic limit to the electron energy in excess of 5 MeV. (auth)

23857 TWO-DIMENSIONAL NUMERICAL STUDY OF BELT-PINCH EVOLUTION. Hofmann, F. (Ecole Polytechnique Federale de Lausanne, Switzerland). Nucl. Fusion; 14: No. 3, 438-441 (Jun 1974).

A conventional, three-fluid MHD-model (electrons, ions and neutral atoms) serves as a basis for these calculations. The model includes the effects of ionization, recombination, resistivity, viscosity, thermal conductivity and ion-neutral collisions. Quasi-neutrality and ideal gases are assumed. Plasma motion in the toroidal direction and Hall currents are neglected. (MOW)

Wave Phenomena

Refer also to abstracts 23761, 23834, and 23839.

23858 (COO-2081-15) FINITE BOUNDARY WIDTH EFFECTS ON SURFACE WAVES IN PLASMAS. Berger, R. L.; Aamodt, R. E. (Colorado Univ., Boulder (USA)). May 1974. Contract AT(11-1)-2081. 16p. Dep. NTIS $4.00.

The effect of plasma density rising smoothly from zero in a vacuum to a constant value in the plasma over a scale length L was examined in relation to its effect on surface wave modification in plasmas. The analysis covers the following topics: (1) flute formalism solutions, and (2) exact solution for electrostatic surface modes. (MOW)

23859 (COO-2081-16) LARGE-AMPLITUDE STATIONARY PERIODIC TRANSVERSE WAVES. Berger, R. L. (Colorado Univ., Boulder (USA)). Jul 1974. AT(11-1)-2081. 24p. Dep. NTIS $4.25.

The equilibrium and stability of transverse magnetic Bernstein-Greene-Kruskal waves to small amplitude perturbations was studied within the framework of the Vlasov-Maxwell equations. An external magnetic field, $B_0 = B_0\hat{e}_z$, is included and spatial variations in equilibrium and perturbed quantities are taken to be in the z direction. The equilibrium state about which the Vlasov-Maxwell equations are linearized supports (self-consistently) a spatially-periodic finite-amplitude transverse electromagnetic wave. The general equilibrium and perturbation equations have been derived previously by the author where it is found that the stability depends on the complex roots ω of a 3×3 matrix dispersion equation that relates the oscillation frequency ω and wavenumber k of the perturbation, provided the equilibrium is circularly polarized and sinusoidal. Explicit examples of self-consistent equilibria are constructed both for the case $B_0 = 0$, which may correspond to the nonlinear saturated state of a Weibel instability, and for the case $B_0 \neq 0$, which may correspond to the nonlinear saturated state of an electron cyclotron instability. In both cases, the electrons magnetically trapped by the equilibrium wave resonantly and nonresonantly interact with trans-

verse wave perturbations of wavenumber $k_0 \pm k$ where $|k| \ll k_0$ to produce unstable sidebands with real frequencies $|\omega_r| \sim \bar{\omega}_{Be}$, where $\bar{\omega}_{Be}$ is the characteristic magnetic bounce frequency for trapped electrons. In addition, the wave equation for stationary transverse waves is considered and a general condition for self-consistent solutions is derived. This condition, which is analogous to the familiar condition on electrostatic waves, states that distribution functions, which are everywhere isotropic in velocity space, cannot support periodic transverse waves. (auth)

23860 (COO-2081-17) NONLINEAR PHENOMENA IN COLLISIONLESS PLASMAS. Progress Report, September 1, 1973-August 31, 1974. Aamodt, R. E.; Berger, R. L.; Hoffman, J. M. (Colorado Univ., Boulder (USA)). 1974. AT(11-1)-2081. 10p. Dep. NTIS $4.00.

The nonlinear development of linearly unstable modes inherent to mirror machines is being analyzed theoretically in order to determine saturation amplitudes and particle loss rates for conventional devices. Nonlinear, nonlocal equations were derived for the classic drift-cone mode which incorporate the nonlinear cross field electro-convection motion. Equilibrium and stability of large amplitude transverse waves was investigated. The problem was shown to be similar in most respects to the BGK large amplitude potential model. Parametric instability studies of ionospheric and laser-pellet plasmas were completed which evaluated the effects of viscosity and plasma inhomogenity on stimulated scattering processes. (auth)

23861 (FUPH-R-97) AXIAL FLOW VELOCITY BEHIND NORMAL IONIZING SHOCK WAVES. Nitschke, P. H.; Brennan, M. H. (Flinders Univ. of South Australia, Bedford Park. School of Physical Sciences). Nov 1973. 6p. INIS.

The axial flow velocity behind a normal ionizing shock wave propagating in hydrogen was determined by measuring the Doppler shift of the H_β line emitted by the shock-heated atoms. The value obtained is consistent with the Chapman-Jouguet hypothesis. (auth)

23862 (IPPJ-172) OBSERVATION OF ION ACOUSTIC WAVE BY MICROWAVE SCATTERING METHOD. Mase, A.; Yamamoti, T.; Tsukishima, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Aug 1973. 17p. NTIS (US Sales Only).

An ion acoustic wave in a current carrying plasma was studied by a microwave scattering method. A technique of incoherent scattering of electromagnetic waves of $f_i = 35$ GHz by ion acoustic waves of $f = 20$ to 70 kHz is described. A dispersion relation and the intensity distribution in k-space of the ion acoustic wave was determined from the angular distribution of the scattered wave. A spatial evolution of the ion acoustic waves along the tube axis was also observed. The observed spatial growth rates are compared with calculated values which take account of both linear and nonlinear growth rates. A good agreement is obtained when the nonlinear effect is assumed as mainly due to the ion-trapping. (auth)

23863 ACCELERATION OF RELATIVISTIC SOLITONS BY AN ELECTRIC FIELD. Khakimov, F.K.; Tsytovich, V.N. (V. L. Lenin Tadzhik State University). Sov. Phys.-Tech. Phys. 18: No. 10, 1362-1363 (Apr 1974).

The acceleration of nonlinear plasma waves by electric fields is investigated. (auth)

23864 CHARACTERISTICS OF ELECTROMAGNETIC WAVES EMITTED FROM AN INHOMOGENEOUS PLASMA LAYER. Galushko, N.P.; Moiseev, S.S. (A. M. Gor'kii Khar'kov State University). Sov. Phys.-Tech. Phys. 18: No. 10, 1376-1377 (Apr 1974).

A study is made of the emission of surface waves at inhomogeneities of open plasma layer waveguides for a magnetized plasma and an isotropic cold plasma. The frequency range within which a single surface wave can exist is established for even and odd E waves. Expressions are obtained for the power emission coefficient for a smooth inhomogeneity at small retardations. It is found that the emission level varies inversely as the operating frequency at frequencies below the plasma frequency. (auth)

23865 EXCITATION OF WAVES IN A GAS DISCHARGE. Pivovarov, I.I. Sov. Phys.-Tech. Phys. 18: No. 10, 1288-1291 (Apr 1974).

A study has been made of the excitation of microwave oscillations in a gas discharge with a grid the cathode-anode space. In such a system, operating modes can be realized in which two electron beams interact with the plasma. The two-beam mode is characterized by the excitation of broad-band noise and by an increase in total power by an order of magnitude. An experimental correlation is established between the form of the electron velocity distribution function, the discharge parameters, and the characteristics of the excited waves. The efficiency of the beam-plasma interaction in the one-beam and two-beam modes is estimated from the spreading of the electron beam. (auth)

23866 RADIAL IONIZATION WAVES NEAR THE CATHODE IN A CONTRACTED GLOW DISCHARGE. Kiselevskii, L.I.; Suzdalov, I.I. (Institute of Nuclear Physics, Academy of Sciences of the Belorussian SSR, Minsk). Sov. Phys.-Tech. Phys. 18: No. 10, 1318-1319 (Apr 1974).

The possible appearance of radial ionization waves near the cathode of a contracted glow discharge is studied. The contraction of the positive column is accompanied by simultaneous axial stratification, and a radial structure consisting of several fixed, alternately bright and dark, regions appears in the cathode-glow region. Both structures may be of an ionization-wave nature. Spectroscopic study of the periodic glow inhomogeneity supports this possibility. (auth)

23867 INTERACTION OF SHOCK WAVES WITH SMALL PERTURBATIONS. Glatman, R.A. (Gipronikel' Design and Scientific-Research Institute, Leningrad). Sov. Phys.-Tech. Phys. 18: No. 10, 1329-1332 (Apr 1974).

Previously unstudied cases of the interaction of a shock wave with small perturbations in ordinary hydrodynamics and magnetohydrodynamics are investigated. General expressions are derived for the pressures in the transmitted wave for oblique incidence of an acoustic wave and for direct incidence of a fast magnetoacoustic wave (when the magnetic field is perpendicular to the direction of wave propagation) on the shock front. For the first case an expression is also found for the angle of refraction of the transmitted wave. The limiting cases of large and small Mach numbers and a strong magnetic field are also analyzed. (auth)

23868 TWO PROPAGATING MODES OF LOW-FREQUENCY WAVES IN A SINGLE-ENDED Q MACHINE. Sato, N.; Sugai, H.; Sasaki, A.; Hatakeyama, R. (Department of Electronic Engineering, Tohoku University, Sendai, Japan). Phys. Fluids 17: No. 2, 456-462 (Feb 1974).

Two propagating modes of low-frequency perturbations are excited by applying oscillating currents to a small coil surrounding a plasma column in a single-ended Q machine. One of them has the same phase velocity and damping factor as grid-excited waves, in spite of quite different exciting mechanisms. The other is observed to propagate only when the exciting frequency is higher than the frequency slightly above the ion cyclotron frequency. Its phase velocity increases with an increase in the magnetic field. This mode follows a dispersion relation of electrostatic ion cyclotron waves propagating along a magnetized plasma column. (auth)

23869 FREQUENCY SHIFT DUE TO RESONANT PARTICLE DIFFUSION IN VELOCITY SPACE. Bornatici, M. (European Space Research Institute, Frascati, Italy). Phys. Fluids 17: No. 2, 498-499 (Feb 1974).

The shift in the frequency of an electrostatic mode due to modification of the ensemble average orbits is considered for an ensemble of electrostatically turbulent, unmagnetized plasmas. (auth)

23870 COILS AND GRIDS AS ION-WAVE LAUNCHERS. Hirshfield, J.L.; Mussetto, M.S. (Department of Engineering and Applied Science, Yale University, New Haven, Connecticut 06520). Phys. Fluids 17: No. 2, 503-504 (Feb 1974).

Similarities between results of ion-wave propagation on a single-ended Q machine using either grid or coil excitation are shown to be not inconsistent with the notion that free-streaming ion motions dominate both cases, contrary to recent claims of Sato et al. (auth)

23871 PROPAGATION OF LASER SUPPORTED DEFLAGRATION WAVES. Boni, A.A.; Su, F.Y. (Systems, Science and Software, La Jolla, California 92037). Phys. Fluids 17: No. 2, 340-342 (Feb 1974).

The propagation of subsonic waves supported by laser energy addition is considered. The propagation velocity is modified to account for radiation diffusion by vacuum ultraviolet photons. A simplified two-band radiation transport model is formulated. (auth)

23872 LINEAR PLASMA OSCILLATION DESCRIBED BY SUPERPOSITION OF NORMAL MODES. Pécseli, H.L. (Danish Atomic Energy Commission, Research Establishment Risø, Roskilde, Denmark). Phys. Fluids 17: No. 2, 378-383 (Feb 1974).

The existence of steady-state solutions to the linearized ion and electron Vlasov equation is demonstrated for longitudinal waves in an initially stable plasma. The evolution of an arbitrary initial perturbation can be described by superposition of these solutions. Some common approximations to the full set of equations can be solved in the same way. In some special cases, relevant, for instance, for single-ended Q machine experiments, a problem with given boundary conditions can be solved by superposition of normal modes. (auth)

23873 NONLINEAR WAVE-PARTICLE INTERACTION IN ELECTROSTATIC WAVES. Martin, P. (Facultad de Ciencias, Universidad de Chile, Santiago, Chile). Phys. Fluids 17: No. 2, 384-389 (Feb 1974).

The unidimensional nonlinear Vlasov equation for electrostatic waves is consistently treated by a perturbation analysis in x-t space, without the usual approximation of small growth or damping rates. This analysis is correct through third-order terms in the field wave amplitude, and it includes the free streaming terms. Assuming the usual quasilinear approximation, a consistent second order analysis leads to a nonlinear

damping decrement γ, which is the usual Landau solution γk of the time-dependent distribution function $f_0(v,t)$ plus an additional term

$$\left(\frac{\partial \epsilon}{\partial \omega}\right)^{-1} \frac{\omega_p^2}{k^2} \frac{1}{v-u} \frac{\partial}{\partial t}\left(\frac{1}{v-u} \frac{\partial f_0(v,t)}{\partial v}\right) dv.$$

This term in the "bump-in-tail" instability increases with the wave amplitude or bounce frequency, it introduces a nonlinear frequency shift and it tends to stabilize the wave at lower saturation levels.

23874 INVESTIGATION OF ION ACOUSTIC WAVES IN COLLISIONLESS PLASMAS. Christoffersen, G.B.; Jensen, V.O.; Michelsen, P. (Danish Atomic Energy Commission, Research Establishment Risø, Roskilde, Denmark). Phys. Fluids 17: No. 2, 390-399 (Feb 1974).

The Green's functions for the linearized ion Vlasov equation with a given boundary value are derived. The propagation properties of ion acoustic waves are calculated by performing convolution integrals over the Green's functions. For T_e/T_i less than about 3 it is concluded that the collective interaction is very weak and that the propagation properties are determined almost completely by freely streaming ions. The wave damping, being due to phase mixing, is determined by the width of the perturbed distribution function rather than by the slope of the undisturbed distribution function at the phase velocity as concluded from normal mode calculations. (auth)

23875 OBSERVATION AND ANALYSIS OF THE ION-ION HYBRID RESONANCES IN PLASMAS OF FINITE LENGTH. Schlueter, H.; Schuerger, G. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik 2). Z. Phys.; 268: No. 2, 251-259(Jun 1974). (In German).

10 figs.; 8 refs.

The ion–ion hybrid resonances are investigated in hot cathode hydrogen and deuterium discharges. There are no observations suggesting an effective angle of propagation smaller than 90°. The effect of finite components of the propagation vector in the direction of the magnetic field is discussed. Relations are given allowing determination of the ion concentrations from the positions of the ion–ion hybrid resonances. (GE)

23876 IGNITION OF LASER DETONATION WAVES. Steverding, B. (U. S. Army Missile Command, Redstone Arsenal, Alabama 35809). J. Appl. Phys. 45: No. 8, 3507-3511 (Aug 1974).

The ignition of laser-supported detonation waves is caused by the thermomechanical response of the target. The blown-off material acts as an accelerating piston creating a shock wave in air. The small amount of free electrons created by the shock wave is cascaded to plasma densities by light absorption. The theory explains a number of conclusions which have been experimentally verified. Numerical results agree with observed data. (auth)

23877 EXPANSION OF SUPERHEATED METALS. Bennett, F.D.; Burden, H.S.; Shear, D.D. (Exterior Ballistics Laboratory, U.S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland 21005). J. Appl. Phys. 45: No. 8, 3429-3438 (Aug 1974).

The short interval of an exploding-wire expansion characterized by rapid rise of resistance, voltage, and electrically deposited energy is studied using time-correlated image-converter photographs, x-ray shadowgraphs, and electrical measurements from identical explosions. Striations in density of the molten expanding core appear concurrently with the electrical signature of the vaporization expansion wave and shortly before billows appear on the boundary surface of the expanding vapor cloud. Even though resolution and penetration do not allow correlation between individual striations and billows, this concurrence suggests that striations are a product of the vaporization process. Arguments are given to show that skin effect and pinch effect do not initiate striation. The same cannot yet be said of Joule heating dependent on the inverse fourth power of radius. Thus striation spacing may reflect underlying departures from uniformity in radius or in microcrystalline structure of the wire. (auth)

23878 COUPLED NONLINEAR ELECTRON-PLASMA AND ION-ACOUSTIC WAVES. Nishikawa, K.; Hojo, H.; Mima, K. (Faculty of Science, Hiroshima University, Hiroshima, Japan); Ikezi, H. Phys. Rev. Lett. 33: No. 3, 148-151 (15 July 1974).

We obtain solutions describing stationary one-dimensional propagation of a coupled nonlinear electron-plasma wave and a nonlinear ion-acoustic wave. These waves have amplitudes linearly proportional to one another, and propagate with approximately the ion-acoustic velocity in the form of periodic wave trains, including solitary waves as a special case. (auth)

23879 PARAMETRIC INTERACTION OF SURFACE AND VOLUME WAVES IN A LAYER OF PLASMA. Aliev, Yu. M.; Gradov, O. M.; Kirii, A. Yu. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 1, 77-83(1974). (In Russian).

A kinetic theory is developed for the dispersion properties of a plasma layer present in an external, homogeneous, high-frequency electric field. Reflection of particles from the plasma boundary is assumed to be mirrorlike. It is shown that as the frequency of the external field approaches particular frequencies of the surface electron oscillations, a parametric resonance arises that leads to an increase in low-frequency, volume ion-acoustic oscillations. Threshold values of the field intensities were found, and values of increments above the threshold were determined. (SJR)

23880 NONLINEAR STAGE OF PARAMETRIC WAVE EXCITATION IN A PLASMA. Zakharov, V. E.; Musher, S. L.; Rubenchik, A. M. (Inst. of Automation and Electrometry, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 151-152(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 249-253(5 Mar 1974).

The spectra of Langmuir turbulence excited by a high-frequency electric field were investigated. It is shown that at large external-field amplitudes the distribution of the oscillations is essentially nonstationary. This leads to an oscillatory character of the energy absorption in the plasma. (auth)

23881 PROPAGATION OF ELECTRON CYCLOTRON WAVE IN PLASMA–BEAM SYSTEM. Bashko, V. A.; Zalesskii, Yu. G.; Musil, I.; Nazarov, N. I. (Physical-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 211-212 (20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 383-385(20 Mar 1974).

It is shown that with the presence of a small fraction of hot electrons in a beam plasma, an appreciable influence is exerted on the damping of an electron cyclotron wave. The measured damping length is in good agreement with cyclotron damping on hot electrons. (auth)

23882 SOUND AND SIMPLE WAVES IN CONDUCTIVE MAGNETIZABLE MEDIUM. Patsegon, N. F.; Tarapov, I. E. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 6, 896-902 (Jun 1974). (In Russian).

The sound wave propagation is considered in magnetizable media. The phenomena of instability when the phase velocity becomes imaginary is discussed. In the case $\mu = \mu(H)$, the equations of the simple waves are obtained and analyzed. (auth)

23883 HIGH-FREQUENCY CONDUCTIVITY OF A TURBULENT PLASMA. Yu, M. Y.; Shukla, P. K.; Spatschek, K. H. (Institut fuer Theoretische Physik, Ruhr-Universitaet, 463 Bochum, F. R. Germany). Phys. Lett., A; 48: No. 1, 61-62(20 May 1974).

The high-frequency conductivity of a steady unmagnetized turbulent plasma is calculated. Numerical results are presented for ion-acoustic turbulence. (auth)

23884 A "d.c. BERNSTEIN MODE" IN A MAGNETIZED VLASOV PLASMA. Hsu, J. Y. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy); Montgomery, D. (Hunter Coll., New York (USA)). Phys. Lett., A; 48: No. 1, 39-40(20 May 1974).

A "d.c. component" in the Bernstein solution for the small oscillations of a magnetized Vlasov plasma is pointed out. This component has apparently not been previously remarked upon. (auth)

23885 THEORY OF SECOND-HARMONIC GENERATION IN AN INHOMOGENEOUS HOT PLASMA. Erokhin, N. S.; Moiseev, S. S.; Mukhin, V. V. (Physical-Technical Inst., Kharkov). Nucl. Fusion; 14: No. 3, 333-339(Jun 1974).

A consistent theory was developed concerning the generation of a second harmonic when an electromagnetic wave is incident on a weakly inhomogeneous isotropic plasma. The dependence of the effect on plasma temperature is studied. The qualitative difference between the mechanisms of second harmonic generation in cases involving low and high temperatures and the oscillatory nature of the intensity of second-harmonic emission are pointed out. Attention is drawn to the strong enhancement of the effect when the density profile has inflection or extremum points. The influence of changes in density profile due to the high-frequency pressure of the incident wave on the generation of the second harmonic is discussed. The significance of second-harmonic generation in the laser-power heating problem is also discussed. (auth)

23886 STABILITY OF WEAKLY IONIZED D-TYPE WAVES IN THE CASE OF AN OPTICALLY THICK LAYER OF IONIZED GAS BEHIND THE WAVE FRONT. Krasnobaev, K. V. Fluid Dyn. (USSR) (Engl. Transl.); 6: No. 6, 921-924(1971).

Translated from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; 6: No. 6, 12-16(1971).

The stability of weakly ionized D-type waves is discussed in the case of a layer of plasma behind the front of a Lyman continuum of hydrogen which is optically thick for quanta. It is shown that stable oscillations are possible. For the characteristic parameters of an interstellar gas, viscous effects may have a stabilizing influence only on shortwave perturbations with wavelength $L \ll L_0$ (L_0 corresponds to neutral oscillations). (auth)

ENGINEERING

Energy Conversion

23887 (AEC-SNS-3063-3) SENSE II: SPACE APPLICATIONS OF NUCLEAR POWER. Volume I. Commercial Communications Satellite. Raab, B. (Fairchild Space and Electronics Co., Germantown, Md. (USA)). May 1974. Contract AT(49-15)-3063. 179p. Dep. NTIS $12.00.

The use of nuclear radioisotope power systems for commercial communications satellites and various military space missions, launched on present-day booster vehicles was studied. This study was intended to provide an evaluation of the competitiveness of radioisotope power systems as compared with solar power systems and to provide power system designers with information on the important operating characteristics of the systems. ^{244}Cm and ^{238}Pu are considered as the radioisotope fuel. The organic Rankine system, Brayton system, and thermoelectric generators were considered as energy conversion systems. It was concluded that: the organic Rankine cycle had a distinct weight advantage over the Brayton system; organic Rankine and selenide-RTG-powered spacecraft are commercially superior to state-of-the-art solar-array/battery-powered spacecraft, and potentially competitive with the most advanced solar-array/battery systems; organic Rankine-system power permits a fully-integrated satellite configuration resulting in a minimum weight design of optimum thermal characteristics; selenide-RTG power permits low-weight design of superior fabrication, integration and start-up characteristics; the relative cost differences between solar and nuclear power can be easily over-shadowed by the relative revenue differences resulting from a net weight advantage of one of the systems; nuclear power systems can match the flat power requirements of commercial communications satellites without need for potentially life-limiting batteries; and with proper design and component selection, a curium heat source can probably be used without in-flight shielding for this mission. (LCL)

23888 (AED-CONF-74-110-011) RADIATION DOSES AND CLINICAL EXPERIENCE WITH THE ISOTOPIC PACEMAKER (^{238}Pu). Kollmeier, W.; Piesch, E.; Burgkhardt, B. 1974. 2p. (In German). INIS. (CONF-740464-1).

From 80th annual meeting of the Deutsche Gesellschaft fuer Innere Medizin; Wiesbaden, F. R. Germany (21 Apr 1974).

1 fig.; 1 tab.

The maximum radiation dose at the surface of ^{238}Pu pacemakers has been determined on patients and phantoms. The average dose rate was 8.1 mrem/h (72 rem/y) consisting of 5.6 ± 0.1 mrem/h for neutrons and 2.54 ± 0.5 mrem/h for γ-rays. The equivalent dose to be expected in the direct environment of a pacemaker amounts of 7.8 rem/y for the body surface, 0.6 rem/y gonad dose in 10 cm distance, and 0.03 rem/y for free air in 50 cm distance. (GE)

23889 NUCLEAR BATTERY WITH SILICON p-n JUNCTIONS. Suzuki, K.; Tabuchi, H.; Ishimatsu, K. (Hitachi Ltd., Kawasaki, Japan). Radioisotopes (Tokyo); 23: No. 5, 282-287(May 1974). (In Japanese).

A nuclear battery, composed of five silicon p-n junctions, five ^{147}Pm beta sources, and a SUS 27 container, is described. Maximum output power and overall efficiency of energy conversion are obtained as 1.2 μW and 0.3%, respectively. The effective source activity is 0.1 to 0.2 Ci for each ^{147}Pm source. The small output power is caused by the weak ^{147}Pm beta sources. Electrical characteristics of a p-n junction element are measured by using a monoenergetic electron beam of which the energy is 50, 75, and 100 keV. The results show that the maximum output power, P_0, and the input power of the electron beam, P_e, has a relation as $P_0 = P_e^x$, where x is equal to 1.2 to 1.3. Optimum junction depth for beta rays from ^{147}Pm to obtain maximum output power was determined to be 2 to 4 μ from the surface of the junction. Reduction of the maximum output power of the p-n junction element caused by radiation damage was measured during 6200 h operation. The experimental results showed that the decrease of the maximum output power was only 5% during the 6200 h. (auth)

23890 MAGNETIC PRESSURE IN HIGH-CURRENT THERMIONIC CONVERTERS. Nevolin, V.K. (Moscow Institute of Electronic Engineering). Sov. Phys.-Tech. Phys. 18: No. 10, 1396-1398 (Apr 1974).

The equations for the transport of a multicomponent plasma are used to analyze the influence of the magnetic pressure in a thermionic converter filled with cesium and barium. Ionization of the barium is neglected in comparison with that of the cesium. An analysis is made of a cylindrical converter with electrodes at specified constant temperatures and potentials. The Hall parameter is assumed small, and the influence of the magnetic field on the transport coefficients is neglected. It is shown that the magnetic pressure in a high-current converter can lead to a relative change in the density of a neutral filler (Ba) as well as to a pressure drop in a multicomponent filler (Cs-Ba). Inequalities which must be satisfied by the filler pressure for maximum current are found. There can be a fractional increase in this current as the filler flows. An equation is found for the limiting converter length for which the magnetic pressure can be neglected. (auth)

23891 STATE OF THE ART AND POTENTIALS OF DIRECT ENERGY CONVERSION. Euler, K. J. (Gesamthochschule Kassel (F. R. Germany). Arbeitsgruppe fuer Technische Physik). Umsch. Wiss. Tech.; 74: No. 6, 175-182(Mar 1974). (In German). 7 figs.; 2 tabs.; 7 refs.

Contrary to commercial power sources the energy conversion serves the purpose of supplementation only. Isotopic batteries, electrochemical fuel cells, thermionic converters and magnetohydrodynamic generators are the main exponents of the energy conversion. Their state and practicability are described. (orig)

23892 SCATTERING OF THERMAL ELECTRONS BY CESIUM AND BARIUM ATOMS UNDER THERMIONIC-CONVERTER CONDITIONS. Babanin, V.I.; Dunaev, Y.A.; Mustafaev, A.S.; Sitnov, V.I.; Ender, A.Y. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.-Tech. Phys. 18: No. 9, 1210-1214 (Mar 1974).

The effect of a transverse magnetic field on the current in a thermionic converter operating under intermediate conditions is used to measure the cross sections for scattering of thermal electrons by neutrals. A thermionic converter with a Cs-Ba mixture is used. The barium vapor controls the work function of the cathode and the directed velocity of the electrons. A method is developed to measure the ratio of the cross sections for scattering of electrons by different neutrals. The cross sections for scattering of thermal electrons by cesium and barium are measured. (auth)

23893 THERMOELECTRIC GENERATOR WITH RADIOACTIVE MATERIAL HEAT SOURCE. Purdy, D. L.; Shapiro, Z. M.; Hursen, T. F.; Maurer, G. W. (to Arco Nuclear). US Patent 3,822,151. 2 Jul 1974. Filed date 10 May 1971. 10p.

An electrical generator having an isotopic heat capsule including radioactive fuel rod as a primary heat source and thermoelectric modules as converters is described. The biological shield for the capsule is suspended from spiders at each end each consisting of pretensioned rods defining planes at right angles to each other. The modules are mounted in cups of transition members of a heat rejection fin assembly whose fins extend from both sides of the transition member for effective cooling. (Official Gazette)

Facilities and Equipment

Refer also to abstracts 23610, 24105, and 25238.

23894 (AD-775782/6) ELECTRO-IONIZATION LASERS. Basov, N. G.; Belenov, E. M.; Danilychev, V. A.; Kerimov, O. M.; Kovsh, I. B. Translated by P. J. Reiff from Zh. Eksp. Teor. Fiz.; 64: No. 1, 108-121(1973). 31p. (FTD-HT-23-471-74). NTIS $3.25.

A study of the electro-ionization method of exciting the working media of gas lasers is described. The conductance of a dense gas medium is created by ionizing radiation from an external source which, by passing an electrical current through the gas, permits the transformation of its energy into energy for exciting the working levels of the molecules. It discusses the mechanism of introducing energy into the active medium of an electro-ionization gas laser and the excitation of the laser working levels. It presents the experimental results of studies on an electro-ionization CO_2 laser operating at CO_2:N_2He mixture pressures of up to 50 atm. (GRA)

23895 (AD-776109/1) HIGH PRESSURE GAS LASER WITH PREIONIZATION BY REACTOR. Andriyakhin, V. M.; Velikhov, E. P.; Vasiltsov, V. V.; Krasilnikov, S. S.; Pismennyi, V. D. Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 637-629(5 Jun 1972). 8p. (FSTC-HT-23-299-73). NTIS $3.00.

The excitation of a CO_2 laser by thermal neutrons from a nuclear reactor is discussed (flow density of thermal neutrons is approximately 5×10^{16} neutrons/cm^2-sec, pulse length about 1 m sec). (GRA)

23896 (GAT-784) DETECTION OF MALFUNCTIONING OIL RINGS IN 2000 HORSEPOWER MOTORS. Jacobs, M. E.

(Goodyear Atomic Corp., Piketon, Ohio (USA)). 31 Jul 1974. Contract AT(33-2)-1. 13p. Dep. NTIS $4.00.

Oil rings, worn to the level of being ineffective, have been detected in operating 2000-hp motors in the Portsmouth Gaseous Diffusion Plant, thereby permitting remedial action before bearing damage from inadequate lubrication resulted. Based on data from a sample of 16 operating process motors with significant audio signals, an 88 percent accuracy has been obtained in identifying motors with badly worn oil rings. A unitized accelerometer-amplifier and spectrum analyzer operating in the 2 to 4 KHz range is the basic instrumentation used for separation of ring signals from background noise. This detection equipment permits the testing of multiple (8 to 12) operating motors in the normal process configuration with a single set-up of electronic components, such as the power supply, oscilloscope, and amplifiers, and requires only approximately 30 seconds to test each set of oil rings. (auth)

23897 (LA-UR-74-26) ROCK MELTING APPLIED TO EXCAVATION AND TUNNELING. Rowley, J. C. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 8p. (CONF-740909-3). Dep. NTIS $4.00.

From third international congress on rock mechanics; Denver, Colorado, USA (1 Sep 1974).

The mechanisms of rock and soil melting are reviewed, and temperatures of ~1800°K are shown to be sufficient to melt most rocks and soils encountered in drilling and tunneling. Laboratory and field tests of several different electrically powered refractory-metal rock-melting penetrators have illustrated the unique role of the fluid melt in affording new solutions to the problems of ground support and materials handling. Chilled to a glass-like lining the melt has been demonstrated to stabilize the bore holes in loose, unconsolidated, wet and dry soils and in low-density rocks. Extruded through ports or flow passages in the penetrator and chilled by a gas coolant, the melt can be formed selectively into glass pellets, glass rods, or rock wool. According to the theoretical model, the penetrator advances at a rate directly proportional to the power supplied to melt the rock or soil. Advance rates and detailed operating performances are predicted from theoretical models of heat-transfer processes, melt-flow fluid mechanics, and penetrator geometry. Predictability of performance has been verified by laboratory experiments and field data; service life and maximum penetration rate depend on the upper temperature limits for structural and heater materials. Analyses and test data have verified the relative insensitivity of the excavation method to wide variations in rock or soil type and strength. The integrated excavation-system approach made possible by rock-melting permits such applications as coring in alluvium; the forming of small-diameter horizontal, glass-lined holes for utility installation; the horizontal coring for tunnel alignment prospecting; and the deep drilling through very hot formations for geothermal energy extraction and geoscience research. (auth)

23898 (UCID-15528) SOME OPERATING LIMITS ON HEAT PIPES. Werner, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Apr 1968. 11p. Dep. NTIS $4.00.

Reasonable approximations for the values of ΔT to produce nucleate boiling in heat pipe wicks for various liquid metals are provided. Some rather general comments on sonic velocity of the heat pipe vapor and entrainment of the liquid in the vapor are made. (auth)

23899 (UCRL-51402) USE OF RELATIVISTIC ELECTRON BEAMS FOR THE STUDY OF CHEMICAL AND RARE GAS LASER SYSTEMS. Krawetz, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Mar 1974. Contract W-7405-eng-48. 77p. Dep. NTIS $7.00.

Thesis.

Chemical ($NF_3 + H_2$) and rare gas molecular (Xe_2, Kr_2, Ar_2) laser systems are examined. Intense relativistic electron beams are used as a source of initiation and stimulation respectively. For the high gain chemical system, nonlinear amplification and pulse propagation are examined. The experimental result shows all the qualitative features of the theoretical prediction. In addition certain kinetic excitation and deactivation mechanisms are studied through the short stimulation time available with the electron beam. Results obtained from the examination of laser action of the test system compare well with more conventional schemes for kinetic rate data extraction. For rare gas molecular systems, the electron beam provided an excellent tool for studying the energy flow beginning with formation of the diatomic eximer to final decay by spontaneous radiative decay. Laser action in Krypton (Kr_2) is predicted. Symmetry in excitation mechanisms is demonstrated for the rare gases as a class. (auth)

23900 ON THE HISTORY OF MEDICAL X-RAY TUBES. First Continuation. Prellwitz, F. (Siemens A. G., Erlangen (F. R. Germany). Unternehmensbereich Medizinische Technik). Roentgenpraxis; 27: No. 2, 38-47(Feb 1974). (In German).

15 figs.

Report on the development of x-ray tubes for medical purposes—from the gas ions tube to the modern hot-cathode tubes is presented. Especially diagnostic tubes experienced a steep and manifold development—a consequence of the increasing demands for better x-ray images. The following development phases are emphasized: tungsten as anode material (1909), heated cathode in high vacuum (1913), line focus (1918), rotary anode (1929), high-temperature radiation cooling of the rotary anode (1933) and double focus trajectory (1957). (GE)

23901 EFFECT OF Ne ADMIXTURES ON GENERATION CONDITIONS OF He–Se LASER AND CONSTRUCTION OF He–Ne–Se GAS LASER. Sabotinov, N. V.; Telbizov, P. K. (Inst. of Solid State Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 6, 763-766(1974).

The investigated He–Se laser represented a glass tube of 0.32-cm inner diameter and 130-cm long. The laser mirrors had a reflection coefficient of 99.5% in the spectral region from 4800 to 5400 Å. The laser output power was measured in relative units by means of photoresistance. Diagrams showing the change in total output power depending upon the ratio of He/Ne are discussed. (MOW)

23902 CONCERNING THE REPRODUCIBILITY OF THE FREQUENCY OF A LASER STABILIZED AGAINST THE TRANSITION FREQUENCY OF THE ABSORBING GAS. Gnatovskii, A. V.; Belenov, E. M.; Danileiko, M. V.; Nikitin, V. V.; Fedin, V. P.; Shpak, M. T. (Inst. of Physics, Kiev). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 205-206(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 368-371(20 Mar 1974).

Power resonances at the centers ω_+ and ω_- of the amplifying and absorbing components respectively, were obtained simultaneously for a ring helium-neon laser with a nonlinear absorbing cell. By varying the pressure in the amplifying medium, these resonances can be made to coincide with accuracy ~10^4 Hz, thus uncovering a possibility of obtaining a high reproducibility, ~10^{-15} in terms of the parameter $(\omega_+ - \omega_-)$, of the frequency of gas lasers. (auth)

23903 QUASISTATIONARY ATMOSPHERIC-PRESSURE CO_2 LASER WITH NON-SELF-MAINTAINING DISCHARGE CONTROLLED BY AN ELECTRON BEAM. Velikhov, E. P.; Zemtsov, Yu. K.; Kovalev, A. S.; Persiantsev, I. G.; Pismennyi, V. D.; Rakhimov, A. T. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 203-204(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 364-368(20 Mar 1974).

Quasistationary generation was achieved in an atmospheric-pressure CO_2 laser with a non-self-maintaining discharge controlled by an electron beam of current density ~50μA/cm². Calculated and experimental values of the weak-signal gain are given. The generation is seen to consist of spikes. (auth)

23904 COLLECTIVE PROCESSES IN DIRECT DISCHARGE ION LASER. Gadetskii, N. P.; Tkach, Yu. V.; Sidel'nikova, A. V.; Zeidlits, V. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 6, 931-935(Jun 1974). (In Russian).

Plasma instabilities are studied developing in a direct discharge laser (I = 2 to 3 kA, U = 4 to 5 kV, Ne ~ 10^{15} cm^{-3}, $T_e \sim T_i \sim 2$ to 5 eV) acting on ion transitions. Correlation analysis helps to determine frequency spectrum and phase velocities of oscillations induced in the plasma ($\Delta f \sim 0.1$ to 5 MHz, $\Delta v_{ph} \sim 2 \times 10^6$ to 10^7 cm/sec). Ion-acoustic and drift-dissipative instabilities proved to be responsible for the induced oscillations. (auth)

23905 COAXIAL GLASS FLASHLAMP AND DYE LASER SYSTEM. Konjevic, R.; Konjevic, N. (Inst. of Physics, Belgrade). Fizika (Zagreb); 6: No. 1, 61-65(May 1974).

A simple, glass, coaxial flashlamp and dye laser system are described. Spectral characteristics of the flashlamp and the influence of the light converter to its emission spectrum are also reported. (auth)

23906 MICROMERITIC STUDIES OF EXPLODED IRON WIRE PRODUCTS. Fang, S. L. Chestnut Hill, MA; Boston Coll. (1974). 204p. University Microfilms Order No. 74-19,216.

Thesis (Ph. D.).

An exploding wire system was used as an aerosol generator for studying the behavior of tracer elements condensed from the vapor phase. The Andersen particle sampler was used to collect the particles produced in the wire explosions. The measured particle size distribution, which appeared to be suitably described by a log-normal distribution function, was established by electron and optical microscopy. The chemical composition

and crystal structure of the particles were studied by x-ray and selected area electron diffraction techniques. Particles produced are essentially bcc α-Fe in argon atmosphere, and fcc Fe_3O_4 in air. Cubic Sb_2O_3, cubic In_2O_3, and orthorhombic TeO_2 were the main oxides produced from the corresponding element coated on the surface of the iron wires. The fractionation behavior of the tracer elements I and its nuclear fission precursors Te, Sb, Sn, and In in the particles was obtained by gamma-ray spectrometry. These tracer elements were all found to have the same distribution pattern in the particles, and to be enriched in the small particles. Surface area calculations revealed that these elements behaved intermediately between surface deposition and volume incorporation. Leachability for these tracer elements in the particles was measured using several media. Different desorption behaviors were observed, both among the elements with a given leaching solution, and for a given element with different leaching solutions. (Diss. Abstr. Int., B)

Heat Transfer and Fluid Flow

Refer also to abstracts 23898, 25867, 25876, 26008, 26014, and 26025.

23907 (FEI-383) COMPONENT CONCENTRATION EFFECT ON THE CRITICAL HEAT FLUX IN BOILING OF SODIUM–POTASSIUM ALLOY UNDER FREE CONVECTION CONDITIONS. Sorokin, D. N.; Kudryavtsev, A. P.; Brigutsa, V. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1972. 10p. (In Russian). INIS.

The method and equipment used and the results obtained in experiments on the effect of concentration of the components on the critical heat flux in the boiling of Na–K alloys are presented. The data are discussed and compared with relationships for nonmetallic binary mixtures. The critical heat flux is a maximum at K concentrations of 20 wt %. (tr-auth)

23908 (FEI-407) NONSTATIONARY TURBULENT FLOW OF INCOMPRESSIBLE LIQUID. Khudasko, V. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 28p. (In Russian). INIS.

Closed systems of Reynold's equations for turbulent non-steady flow are analyzed using the statistical model of turbulence (Kolmogorov, Rott, et al.) and equations for the transfer of turbulent energy. A review of work on the study of the structure of non-steady turbulent flow is reported. Questions on the coefficient of friction in non-steady turbulent flow are examined. (tr-auth)

23909 (FEI–417) PROFILES OF VELOCITY IN SMOOTH AND IN ROUGH PIPES. Millionshchikov, M. D.; Subbotin, V. I.; Ibragimov, M. Kh.; Taranov, G. S.; Kobzar, L. L. (Gosudarstvennyj Komitet po Isopol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 36p. (In Russian). Dep. NTIS (US Sales Only) $5.00.

An analysis was made of existing formulas for velocity profiles in smooth and rough pipes. The reliability of the formulas was verified by comparison with experimental data. On the basis of the experimental curves for flow around rough surfaces, an effective diameter for rough pipes was introduced which can be used in the calculation of the integral flow characteristics and from which can be determined the distance from the walls. With the use of the effective diameter, good agreement was obtained between the measured and theoretical velocity profiles. A method is proposed for the calculation of the velocity profiles in rough tubes by the experimentally determined coefficient of hydraulic resistance at a given Reynolds number. (tr-auth)

23910 (FEI–418) METHODOLOGY OF CALCULATION OF THE COEFFICIENT OF HYDRAULIC RESISTANCE AND THE RATE PROFILE IN A PIPE WITH REGULAR ROUGHNESS. Kobzar, L. L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 46p. (In Russian). Dep. NTIS (US Sales Only) $5.50.

Turbulent flow in pipes with regular roughness formed by similar proturberances equally distributed on the pipe surface was examined. The form of the proturberances is arbitrary (circles and mounds of different configuration). It was assumed that the resistance of the rough pipes consists of resistance of smooth pipes at a given Reynolds number and the sums of the resistance of the forms of the roughness elements. For calculation of the resistance of the forms of the individual roughness elements a method was proposed taking into consideration the distribution of the velocities on the pipe walls and the interaction of the proturberances. Experimental pictures of the flow around roughnesses were used during consideration of the proturberance interaction. On this basis the effective values of the pipe diameter and the front cross section of the roughness were determined. (tr-auth)

23911 (FEI–421) MEASUREMENT OF SOME CHARACTERISTICS OF A STEAM-LIQUID STREAM IN A PIPE AT PRESSURE AT 68.6 BAR. Kirillov, P. L.; Komarov, N. M.; Subbotin, V. I.; Smogalev, I. P.; Suborov, M. Ya.; Shtein, Yu. Yu.; Shumskii, R. V.; Shikovskii, Yu. D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 104p. (In Russian). Dep. NTIS (US Sales Only) $8.25.

The experimental method and installation for measurements on a steam-liquid stream are described. These consisted of the electric resistance probe, the isokinetic probe, installation for transmission for measurement of such structural characteristics of the steam-water stream at high pressure as thickness of the liquid film distribution of the linear and weight rates of the phase, the true volume of the steam content, and hydraulic resistance. The test results are reported and the basic results obtained on steam-water streams in circular pipes at 68.6 bar are discussed for the following region of regime parameters: $_{\gamma}W = 500$ kg/m^2 sec with $0 \leq \times \leq 0.95$, $_{\gamma}W = 750$ kg/m^{2}sec with $0 \leq \times \leq 0.85$, and $_{\gamma}W = 1000$ kg/m^{2}sec with $0 \leq \times \leq 0.50$. Carrying out the experiments in the adiabatic and diabatic conditions made it possible to clarify the effect of heat current on the characteristics of the two-phase flow. (JSR)

23912 (FEI–426) CONCERNING THE FLOW OF A TWO-COMPONENT STREAM IN THE CHANNEL OF A TRIANGULAR CROSS SECTION. Ibragimov, M. Kh.; Poletaev, G. P.; Sidorov, V. I.; Chernetskii, E. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 28p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The results of the experimental study of water–air streams, flowing in bubble regime through a straight channel having a cross section of an isosceles triangle with acute angle at the top, are reported. It is shown that the gas bubbles in the conditions given settle out on the wall in the region of the acute angle. Data are given on the effect of the average flow rate, the average volume flow-rate gas contents, wettability, and value of the acute angle at the top on the dimensions of the precipitated bubbles. (tr-auth)

23913 (IAE-2287) EFFECT OF BOUNDARY CONDITIONS ON VALUE OF THERMODYNAMICAL POTENTIAL OF MONOPHASE. Belousov, I. G.; Pavlov, V. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 8p. (In Russian). INIS.

The change of the thermodynamic potential of water under the effect of its contact with solid glass walls was studied by the galvanic method and the method of capillary boiling. The experimental results were treated by supplementary terms in the basic thermodynamic equation, equal to the differential of the product of the specific energy of the energy of the interaction of the liquid and wall and the specific contact surface. The values of the specific energy of the water–wall pair, measured by the methods cited, were equal to $(1.68 \pm 0.2) \times 10^4$ J/m^2 and $(1.9 \pm 0.2) \times 10^4$ J/m^4, respectively. Some consequences resulting from the proposed generalization of the thermodynamic equation were examined. (tr-auth)

23914 (ORO-3936-9) VAPOR EXPLOSION HEAT TRANSFER AND FRAGMENTATION. VI. Transient Film and Transition Boiling from a Sphere. Stevens, J. W.; Witte, L. C.; Cox, J. E. (Houston Univ., Tex. (USA). Dept. of Mechanical Engineering). Sep 1972. Contract AT(40-1)-3936. 92p. Dep. NTIS $7.75.

Energy transfer and vapor film destabilization processes have been studied in an experiment where a sphere traveling with a constant velocity of 5 ft/s was quenched in distilled water. Data were obtained for the instantaneous heat flux and the transient vapor film behavior over a range of sphere temperatures from 500 to 1000°F and water subcoolings from 52 to 136°F. The nature of the transient vapor film behavior was studied with high-speed photography during quenching. All experiments were performed at atmospheric pressure. Two distinctive mechanisms for the destabilization of a stable vapor film were identified. One, a precipitous collapse and the other, progressive instability. The precipitous collapse occurs very rapidly, on the order of 0.25 ms, while the progressive instability requires from 50 to 100 ms for completion. The progressive instability is triggered by small bubble-like irregularities that move on the liquid-vapor interface. Precipitous instability appears to be dependent on heat flux rather than sphere temperature. (auth)

23915 (UCID-15468) HTRZ: A TWO DIMENSIONAL CYLINDRICAL HEAT TRANSFER CODE. Lee, J. D. (California

Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Jan 1968. 24p. Dep. NTIS $4.25.

A code (HTRZ) written to solve heat transfer problems associated with fuel irradiation capsule design is described. Objectives, methods, input, output, a sample problem, test problems, and code listing are included. (auth)

23916 (UCID-15519) ANNULAR HEAT PIPE THEORY. Watts, J. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Nov 1966. 29p. Dep. NTIS $4.50.

The present interest in an annular type heat pipe was prompted by a proposal to irradiate a capsule of UN to study radiation damage. An annular heat pipe would be excellent as a temperature control device. Using the usual assumptions regarding fluid flow, the Navier-Stokes equation can be solved analytically for the annular type heat pipe. The solution is carried out in detail. An additional first order approximation formula which is not only easy to use but sufficiently accurate for all practical cases is presented. (auth)

23917 (UJV-3154-R) EXPERIMENTAL RESEARCH OF HEAT TRANSFER COEFFICIENT DISTRIBUTION ON A PLATE WITH LONGITUDINAL FINS BY MEANS OF ANALOGY BETWEEN HEAT AND MASS TRANSFER. II. Malak, J.; Hejna, J.; Cervenka, J. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). May 1974. 57p. (In Czech). Dep. NTIS (US Sales Only) $5.00.

The main results of an experimental investigation of local heat transfer coefficient distribution for developed turbulent flow in non-circular channels are described. The investigation used napthalen-model techniques to obtain an analogy between heat and mass transfer. Longitudinally finned flat channels were investigated. This type of channel represents one of the most complicated geometries which occur in practice. This work is a continuation of experimental investigation of local hydrodynamic conditions in channels of the same geometry. The main attention was devoted to the local heat transfer coefficient distribution along the wetted perimeter at developed hydrodynamic and thermokinetic conditions and to the relation between local values of heat transfer coefficient and wall shear stress. The experimental results confirm the theoretical relationship between the two quantities, which was derived using an analogy between momentum and heat transfer. Further, the results obtained make it possible to evaluate the variation in transfer conditions along the channel. (auth)

23918 SIMPLE DYNAMIC MODELS FOR DOUBLE-PIPE AND TUBE-BUNDLE HEAT EXCHANGERS. Puetter, L. Aachen, Ger.; Technische Hochschule (1972). 140p. (In German). INIS. 13 figs.; 22 tabs.; 29 refs. With abstract in German.

The double-pipe heat exchanger can be considered as a standard system permitting the study of all relevant and important properties of heat exchangers. Therefore, it can be used as a basic system or main element for the description of many other types of heat exchangers, and a detailed knowledge of the dynamic behavior of double-pipe heat exchangers will provide the necessary basis for further investigations on other types of heat exchangers. (GE)

23919 EXPERIMENTAL RESEARCH ON TWO-PHASE FLOW OF CRYOGENIC FLUIDS. Tuberga, A. (Inst. of Technical Physics, Turin). Termotecnica (Milan); 28: No. 2, 102-104(Feb 1974). (In Italian).

Peculiar characteristics in two-phase flow of cryogeinc fluids are considered, and some recent equipment for the determination of the pressure loss and heat flux in these flowing fluids is described. (auth)

23920 METHOD FOR DETERMINING THE VOID FRACTION IN TWO-PHASE AMMONIA FLOWS. Fridman, B. A. (All-Union Research Inst. of the Refrigeration Industry, Moscow). Heat Transfer-Sov. Res.; 6: No. 2, 24-29(1974).

A method is described for determining the void fraction of two-phase ammonia flows, based on differences of the dielectric permeability of the liquid and gaseous phases. The void fraction is determined in a vertically moving two-phase flow. Measurements point to the presence of substantial "slip" of the vapor phase of the refrigerant. (auth)

23921 CONCERNING THE BOILING OF FREON-22 AND 502 ON A TUBE BUNDLE AT LOW TEMPERATURES. Mednikova, N. M. (All-Union Research Inst. of the Refrigeration Industry, Moscow). Heat Transfer-Sov. Res.; 6: No. 2, 30-37(1974).

The boiling heat transfer coefficients for F-22 and 502 on a surface of a six-row bundle of smooth tubes at boiling temperatures up to -60°C were studied. The boundaries were determined of the transition region from free convection to nucleate boiling at the bundle as a function of the boiling temperature. Relationships are suggested for calculating the heat transfer in the region under study. (auth)

23922 MATHEMATICAL MODEL FOR ONE-COMPONENT UNSTEADY-STATE TWO-PHASE CRITICAL FLOW IN A LONG PIPELINE. Pajoumand, G. Tulsa, OK; Univ. of Tulsa (1974). 177p. University Microfilms Order No. 74-18,309.

Thesis (Ph. D.).

Using unsteady and steady-state conservation laws of mass, momentum and thermal energy, a mathematical model was developed that describes velocity, pressure, and temperature in the subcooled as well as saturated region of a pipeline after a rupture has occurred at one end, while the inlet valve is being closed. A separated flow model as well as nonequilibrium thermodynamics was assumed to exist between vapor and liquid in the saturation region. This model gives rise to a set of nonlinear, nonhomogeneous ordinary differential equations during steady-state and a set of first order partial differential equations during unsteady-state flow. The differential equations were solved using fourth order Runge-Kutta and the partial differential equations were solved using an implicit finite difference approximation. Steady-state equations were used as initial conditions for the unsteady-state equations. The boundary conditions for the unsteady-state equations were solved for by trial and error at any time increment. The resulting finite difference equations and the differential equations were programmed on Xerox Sigma Six Computer at the University of Tulsa's Computer Center. It was found that the uniqueness of the solution of the partial differential equations is heavily dependent on the exact location of the interface between subcooled and saturated liquid region. The variation of the interphase mass transfer coefficient, during steady-state flow, from 0.004 to 0.006 did not have too much effect on the distance covered by the fluid as two-phase. When interphase mass transfer coefficient is zero (no vapor is being generated) the finite difference equations do not converge. Also the following was observed: (1) The distance covered by the two-phase proved to be very sensitive toward the variation in the inlet valve pressure. An algorithm is developed for converging to the right pressure at the valve. (2) During unsteady-state two-phase flow, critical flow is obtained when the determinant of the coefficient matrix approached infinity for a given time increment and distance increment. (3) Most of the fluid loss from the pipeline is one minute after the inlet valve is closed. (4) After four minutes and fifteen seconds from steady-state, the solution to the transient flow operations indicated that an infinite number of small time increments are required for obtaining the solution of the equations when the valve is completely closed. This seemed to be not practical and time consuming. A three dimensional extrapolation is proposed for determining the solution when the valve is closed and thereafter. (Diss. Abstr. Int., B)

23923 NUCLEATION AND BUBBLE GROWTH FROM ARTIFICIAL CAVITIES IN A FIELD OF KNOWN INITIAL TEMPERATURE DISTRIBUTION. Schultz, R. R. Potsdam, NY; Clarkson Coll. of Tech. (1974). 354p. University Microfilms Order No. 74-16,907.

Thesis (Ph. D.).

Incipient nucleation and initial bubble growth from single artificial cavities were investigated to determine the effect of initial liquid temperature distribution. Transient heating periods of short duration (7 to 103 milliseconds) were employed so that the liquid temperature distribution could be computed analytically from the transient conduction equation. Experiments were conducted with water at pressures of 8.2, 12.4, 22.7, and 39.7 kN/m^2 using a single artificial cavity having a radius of 42 μm. The incipient nucleation data could not be well represented by any of the existing analyses, including the Madejski model. It is suggested that the proposed nucleation criteria are themselves insufficient for nucleation into a field of non-uniform superheat. The initial bubble growth data confirmed that liquid inertia is an important retarding force during the initial stages of growth. At the same time, surface tension forces and the liquid temperature distribution in the thermal layer adjacent to the hot surface are shown to dramatically affect the stability and subsequent growth or collapse of the just nucleated vapor bubbles. (Diss. Abstr. Int., B)

23924 TURBULENT HEAT TRANSFER FOR PIPE FLOW WITH PRESCRIBED WALL HEAT FLUXES AND UNIFORM HEAT SOURCES IN THE STREAM. Chung, B. T. F.; Thomas, L. C. (Univ. of Akron, OH). J. Heat Transfer; 96: No. 3, 430-431 (Aug 1974).

An analysis is presented to estimate heat transfer characteristics for turbulent fully developed flow with constant heat generation in the fluid and uniform heat flux at the tube wall. The present model appears to be much simpler than the earlier eddy diffusivity models. The expression of dimensionless wall to bulk temperature difference derived on the basis of the present analysis is easy to use while the results are in reasonable agreement with the available data. Although the predictions for adiabatic wall-to-bulk temperature difference based on the surface renewal and

eddy diffusivity models are not in complete agreement throughout the entire range of Reynolds numbers, the trends and the orders of magnitude are consistent. (auth)

23925 INFLUENCE OF TWISTED TAPES IN SUBCRITICAL, ONCE-THROUGH VAPOR GENERATORS IN COUNTER FLOW. Cumo, M.; Farello, G. E.; Ferrari, G.; Palazzi, G. (CNEN, Casaccia, Italy). J. Heat Transfer; 96: No. 3, 365-370(Aug 1974).

The swirl flow of Freon 12 in a tubular heat exchanger, indirectly heated by forced convection of water in an annular gap was studied. Two identical situations were compared with and without a twisted tape, to deduce the influence of the swirl flow in the particularly interesting boundary condition of indirect heating by another fluid (and not simply of uniform Joule heating). The heat transfer is greatly increased by the swirl flow, up to a factor of two at the burnout or dryout point. (auth)

Materials Testing

Refer also to abstracts 24488, 24603, 24741, and 25894.

23926 THE USE OF ACOUSTIC EMISSION TO DETECT INCIPIENT FAILURE IN PRESSURE VESSELS. Bell, R. L. (Dunegan/Endevko, San Juan Capistrano, Calif. (USA)). Kerntechnik; 16: No. 5, 216-222(May 1974).

14 figs.; 51 refs.

The application of acoustic emission technology to field evaluation of nuclear reactor pressure vessels has been successfully accomplished. At present, both the acoustic emission monitoring of hydrotests and continuous acoustic emission surveillance are being used for this purpose. A number of technological advances have been made in the past several years that have provided new hardware and basic material information. These include new transducers, full-scale computerized location systems, various location algorithms, material studies of reactor steels, fatigue crack growth studies in reactor pressure vessels, etc. (auth)

23927 EDDY CURRENT EVALUATION OF NUCLEAR CONTROL RODS. Dodd, C. V.; Smith, J. H.; Simpson, W. A. (Oak Ridge National Lab., TN). Mater. Eval.; 32: No. 5, 93-99(May 1974).

An eddy current technique was developed and performed to detect cracks and measure thickness of cladding and oxide thickness on new and used nuclear control rods for the High Flux Isotope Reactor at the Oak Ridge National Laboratory. A computer design was performed for coils to maximize sensitivity to surface cracks and cladding thickness variations and minimize effects due to liftoff and temperature variations. In spite of radiation levels measured to be 10^5 R/h at 1 ft from the surface and temperature variations of 5°C on used control rods, flaws as small as 0.001 in. were detected, and the cladding thickness was measured to within 0.001 in. (auth)

23928 ULTRASONIC HOLOGRAPHY THROUGH METAL SLABS. Toffer, H. Seattle; Univ. of Washington (1974). 107p. University Microfilms Order No. 74-15,528.

Thesis (Ph. D.).

The techniques of scanned ultrasonic holography were developed for imaging and interpreting information from objects located behind massive metal barriers. The retrieved information was contained both in the observable interference patterns composing the hologram and the reconstructed images derived from it. To understand the impact of the barrier on holographic techniques, holograms of spherical and plane wave sources were recorded through metal slabs. The observed perturbations due to mode conversions and multiple reflections were correlated with analytic techniques. Arising from these studies were procedures for imaging complex target configurations using a focused spherical transducer operating in a pulse echo mode at normal incidence with an electronically shifted reference beam. Diffusely and specularly reflecting objects were successfully imaged through 2.56 cm, 5.00 cm, and 10.21 cm thick flat, and a 5.08 cm thick curved cylindrical surface aluminum slabs. The limitations of ultrasonic holography through material barriers and the effect of such barriers on the imaging equations were tested against measurements. Possible applications of the technique in the nuclear industry were considered. The potential imaging of irradiated fuel elements in metal covered storage cubicles was explored in detail. (Diss. Abstr. Int., B)

Nuclear Explosions

Refer also to abstracts 23524, 23975, 23982, 23983, 24012, and 26120.

23929 (AD-775635/6) FALSE ALARM PROBABILITIES FOR MIXED EVENTS. Cohen, T. J.; Sweetser, E. I. (Teledyne Geotech, Alexandria, Va. (USA)). 5 Nov 1973. Contract F08606-74-C-0006. 62p. (SDAC-TR-73-8). NTIS $3.75.

Analysis of 1.471 P- and PKP-CODA indicates that the probability of an unexplained phase occurring in CODA of an event as recorded at a single station is 0.12 for a detection threshold on the order of 3.5 db (signal-to-CODA background). The average CODA length is roughly six minutes (343 s) for the events examined. The probability, therefore, that the seismograms at four stations out of thirteen will exhibit unexplained phases in the CODA of a given earthquake is 0.045. (auth)

23930 (AD-775638/0) SEISMIC DISTANCE-AMPLITUDE RELATIONS FOR SHORT PERIOD P, PDIFF', PP AND COMPRESSIONAL CORE PHASES FOR DELTA LESS THAN 90 DEGREES. Sweetser, E. I.; Blandford, R. R. (Teledyne Geotech, Alexandria, Va. (USA)). 5 Nov 1973. Contract F08606-74-C-0006. 49p. (SDAC-TR-73-9). NTIS $3.25.

Measurements of log(A/T) reported by the International Seismic Center, the Vela Observatories, and the Long-Range Seismic Measurements Program are used to define an amplitude-distance curve for the maximum amplitude in the first few seconds of motion for the distance range delta > 90 degrees. In general terms, the corresponding phases are P, P (DIFF), and PKIKP. Some information is also obtained, however, for the phases PP and PKP2. (auth)

23931 (AWRE-O-10/74) PEACEFUL USES OF NUCLEAR EXPLOSIVES. Review Paper No. 3. Air Blast from Underground Nuclear Explosions: an Introductory Guide. Whiteside, T. (UKAEA Weapons Group, Aldermaston, Atomic Weapons Research Establishment). Jun 1974. 40p. Dep. NTIS (US Sales Only) $5.00. UK pounds 1.

This review outlines the main characteristics of air blast, factors affecting its propagation, the mechanism of generation of air blast by an underground nuclear explosion, methods of prediction, and damage criteria. (auth)

23932 (AWRE-O-17/74) PEACEFUL USES OF NUCLEAR EXPLOSIVES. Review Paper No. 4. Monitoring Yields of Underground (PNE) Explosions from Normalized Amplitudes of Seismic Signals. Thirlaway, H. I. S. (UKAEA Weapons Group, Aldermaston, Atomic Weapons Research Establishment). Aug 1974. 25p. Dep. NTIS (US Sales Only) $4.25. UK 50 pence.

Seismological methods for estimating yields of underground nuclear explosions are reviewed in the light of peaceful applications. The use of surface (Rayleigh) waves for this purpose is advocated. Evidence on which this recommendation is made is appended. (auth)

23933 (JPRS-62595) EFFECT OF UNDERGROUND EXPLOSIONS AND CHANGES IN PROPERTIES OF A MEDIUM IN A SEISMICALLY ACTIVE REGION. Translated from Dokl. Akad. Nauk SSSR; 215: No. 5, 1097-1104(1974). 18p. NTIS.

A separate abstract was prepared for one of the two papers contained in the report. The remaining paper is not within the subject scope of NSA. (TFD)

For an abstract of an individual paper see: 23934.

23934 (JPRS-62595, pp 1-7) SEISMIC ACTION OF UNDERGROUND EXPLOSIONS. Sadovskii, M. A.; Kostyuchenko, V. N. 29 Jul 1974. Translated From Dokl. Akad. Nauk SSSR; 215: No. 5,1097-1100(1974).

The effects of seismic waves from underground nuclear explosions on buildings are discussed. (TFD)

23935 (LA-5647-MS) SHORT ACCOUNT OF LOS ALAMOS THEORETICAL WORK ON THERMONUCLEAR WEAPONS, 1946-1950. Mark, J. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1974. Contract W-7405-eng-36. 15p. Dep. NTIS $4.00.

A factual account of work (mainly theoretical) on thermonuclear weapon development at the Los Alamos Scientific Laboratory from 1946 to 1950 is presented. This is an unclassified version of a chapter (written in 1954) for a proposed technical history. It outlines the computational and theoretical work devoted to study of the Super and other thermonuclear problems. (auth)

23936 (LA-tr-74-22) FORMATION OF A RING-SHAPED VORTEX IN THE RISING OF A LIGHT GAS IN A HEAVY ONE. Glagoleva, Yu. P.; Zhmailo, V. A.; Mal'shakov, V. D.; Nesterenko, L. V.; Sofronov, I. K.; Statsenko, V. P. Translated by H. J. Dahlby from Chislennye Metody Mekh. Sploshnoi Sredy; 5: No. 1, 38-52(1974). 18p. Dep. NTIS $4.00.

A numerical solution to reproduce the problem of the rising of a heated gas bubble in a cold gas is attempted. In the case of an atmospheric atomic explosion cloud, after separation of the shock wave to a considerable distance from the point of the explosion,

a ball of hot air (the explosion cloud) remains in place for a few seconds, then rises under the influence of gravity into a ring-shaped vortex. During this phase the maximum rate of ascent is achieved, then decreases to zero. Due to the circulating movement in the cloud and outside it, which developed in the initial stage of the ascent, the cloud considered as a homogeneous ball, undergoes the effect of the Zhukovskii force and expands in the horizontal direction. The deformation of the cloud in its ascent is accompanied by the development of a gravitational instability and an instability caused by the tangential discontinuity of the velocities. The development of both types of instability in the end leads to turbulent mixing at the boundary at the cloud. The evolution of the explosion cloud into a torus is shown graphically. (MCW)

23937 (ORNL-4966, pp 71-72) CHEMICAL APPLICATIONS OF NUCLEAR EXPLOSIVES. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

23938 (SAND-74-8209) PLOWSHARE PROGRESS REPORT FOR QUARTER ENDING JUNE 30, 1974. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 5p. Dep. NTIS $4.00.

Research progress is reported on high-temperature arming and firing components, control switches, destruct systems, safe-secure trailer, and Plowshare secure container. (TFD)

23939 (SLA-74-0328) PORE PRESSURE ENHANCEMENTS OBSERVED ON RIO BLANCO. Banister, J. R.; Ellett, D. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 41p. Dep. NTIS $5.25.

The experimental layout of the Pore Pressure Measurements Program established by Sandia Laboratories on the RIO BLANCO experiment is described. Measurements of change in pore pressures and accelerations taken in the saturated clayey silt (ML) in the Fawn Creek and Black Sulphur Valleys at 2.1, 4, 7, and 10 kilometers from surface zero are given. The time histories of the ground motion and the pore pressures are correlated using several methods. Liquefaction was considered probable but was not observed and the pore pressure increases were one-quarter or less than those associated with liquefaction. (auth)

23940 (UCID-15391) INTEGRATED CONTROL SYSTEM. Ragsdale, W. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Oct 1968. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

An integrated control system that provides the basic and secondary functions for a Plowshare field operation is described. The basic functions are those to be found at every event and which are required to perform the fundamental detonation mission. These functions are: (1) arming and firing commands in the explosive canister and at surface ground zero; (2) Environmental monitors and suitable arming monitors in the explosive canister; and (3) safety monitors at the zero site for weather, RAMS (Remote Area Monitoring System), and cavity collapse. Secondary functions are those that may be required for a specific project by administrative or technical considerations. These functions are: (1) scientific program of phenomenology measurements; (2) explosive performance measurements from fiducial, detectors, prompt gas sampling, and earth motion; (3) ground zero television; and (4) auxiliary communications such as local telephones and VHF radio. The equipment to perform these functions is contained in trailers or containers suitable for use in remote areas. The system block diagram (LEA 68-108304) outlines the major equipment items and locations. Trailer 98 houses the control room. All signals to and from ground zero are by microwave radio link. (auth)

23941 (UCID-15404) POST-OPERATION REPORT LASER TELEMETRY EXPERIMENT ON THE STODDARD EVENT. Fong, P. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Oct 1968. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

A laser telemetry experiment in transmitting data produced by a downhole nuclear detector fielded by the Electro-Optical Diagnostics Group on the Stoddard Event is described. From a location close to ground zero, the information was transmitted through the atmosphere on a laser beam to a receiver trailer 8000 ft away. (TFD)

23942 (UCID-15409) SUGGESTED METHOD FOR INVESTIGATING AND REDUCING VENTING FROM NTS EVENTS. Grens, J. Z. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Nov 1968. Contract W-7405-eng-48. 10p. Dep. NTIS $4.00.

Several recent events at NTS have been accompanied by the release of a large amount of steam and gas to the atmosphere as leakage through the soil. The venting begins a few seconds after detonation and continues until cavity collapse. Most events on which this phenomena have been observed have included a line-of-sight pipe to the ground surface. Although this pipe is fitted with closure mechanisms, it remains the link between events which have vented in this manner. It was decided to examine, qualitatively, the way in which a pipe of this type could contribute to gas release, and to attempt to suggest solutions to this problem or meaningful experiments which aid in later solution. By examination of several possible flow paths, it was concluded that: the balance of the distance from the cavity to the surface is traversed in the line-of-sight pipe; a break in the pipe wall within 100 feet of the surface is necessary for venting unless considerable soil movement occurs; thermocouples buried outside the emplacement casing would be useful in diagnosis of future problems; closure mechanisms (pipe cutters) should be located some distance from the device, but no less than 300 feet from the surface; and a weakened section in both pipes, at about the 300 foot level, might reduce the likelihood of surface gas release. (auth)

23943 (UCID-15459) CALCULATIONS OF ADIABATS AND HUGONIOTS FROM ISOTHERMS. Stephens, D. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 May 1969. 21p. Dep. NTIS $4.25.

Isothermal PV data for a saturated tuff were used to calculate the Hugoniot and an adiabat off the Hugoniot. The method of Walsh and Christian was used. The calculations showed that the PV data were essentially the same to pressures of 3 kbar, after which the differences increased to a maximum of 20% at 30 kbar. Thus, the distinctions between the three PV curves are important for compressible rocks at rather moderate pressures. (auth)

23944 (UCID-15554) INTRODUCTION TO FISSION EXPLOSIVES. Selden, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1969. 22p. Dep. NTIS $4.25.

A general treatment of the physics which leads to the possibility of a fission explosion and a representative view of the unclassified information about the physics, design and early histroy of atomic bombs are presented. (TFD)

23945 (UCID-15590) PRELIMINARY EVALUATION OF ROUTE 23 (NUCLEAR). Toman, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1969. 59p. Dep. NTIS $6.00.

A preliminary examination of the technical feasibility of using nuclear explosions to excavate a sea-level canal through the Tuira River valley of eastern Panama and the Atrato swamps of northern Colombia is presented. (TFD)

23946 (UCID-15641) GAS FLOW, PERMEATION, SEEPAGE FROM UNDERGROUND SOURCES: A SIMPLIFIED ANALYTICAL APPROACH. Heckman, R. A.; Rozsa, R. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Apr 1970. 15p. Dep. NTIS $4.00.

A synopsis of a presentation made March 12, 1970 before the Nevada Test Site (NTS) Planning Board Radioactive Effluent Subcommittee is presented. The results presented are preliminary in nature and meant to serve only as an introduction to the type of numerical calculations being applied to the general area of underground gas movement. (auth)

23947 (UCID-15643) VENTING MODEL FOR GAS STIMULATION EXPERIMENTS. Sherwood, A. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Apr 1970. 12p. Dep. NTIS $4.00.

The problem of making a viable calculation of venting (late-time leakage) following a nuclear explosion in an underground natural gas reservoir is discussed. (TFD)

23948 (UCID-15670) METHOD FOR REDUCING PRESSURE ON FIRST HE MACHINE IN LINE-OF-SIGHT PIPES. Glenn, H. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 May 1970. 12p. Dep. NTIS $4.00.

An expansion chamber technique is proposed to reduce cavity gas pressures on the first HE machine in line-of-sight closure systems. A theoretical study was performed that indicates stagnation pressures on the first HE machine are reduced by a factor of 3 for approximately the first 10 msec after device detonation. Thus the expansion chamber should triple the time the first HE machine would be effective in retarding cavity gas flow up the LOS pipe. This delay might be enough to allow ground closure of the LOS pipe, or other closure systems above the first He machine to function. (auth)

23949 (UCID-15691) 24.5-IN.-I. D. HIGH-EXPLOSIVE PIPE CLOSURE. Page, J. R.; House, P. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jul 1970. 43p. Dep. NTIS $5.25.

The design of line-of-sight systems for the Packard and Crew Events created a need for two new large-diameter, high-explosive pipe closures. Closures having initial open diameters of 18.8 and 24.5 in. were accordingly developed. The 24.5-in.-ID closure and its capabilities are described and the developmental program that was undertaken to produce it is discussed. (auth)

23950 (UCID-16579) RIO BLANCO GAS COMPOSITION LLL DATA SUMMARY CALIBRATION AND PRODUCTION TESTING OF RBE-01. Smith, C. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Aug 1974. Contract W-7405-eng-48. 54p. Dep. NTIS $5.75.

The chemical composition and radionuclide concentration of Rio Blanco chimney gas samples collected during calibration and production testing of the RBE-ϕ1 well is presented. A brief summary of the analytical procedures used, and of their attendant uncertainties is provided in conjunction with a description of the conventions adopted for the data presentation. Analytical data, as presently available, are included for each sample received for processing by LLL. Sufficient additional information is included to permit the reader to associate the analytical data with the progress of well testing operations. (auth)

23951 CRUSTAL STRAIN MEASUREMENTS IN NEVADA. Priestley, K. (Univ. of Nevada, Reno). Bull. Seismol. Soc. Amer.; 64: No. 4, 1319-1328(Aug 1974).

Strain measurements at two sites in central Nevada, Round Mountain and Mina, indicate that, in this area of the Basin and Range, strain rates are less than 2×10^{-6} per year. These observations are in agreement with estimated spreading rates and geodetic measurements in the Great Basin. The general agreement between strain-meter observations at Round Mountain and nearby focal mechanism solutions suggests that we are observing strain accumulation in this area. The long-term strain at Mina is more variable, but generally agrees with earthquake focal mechanism solutions. The strain rate, in conjunction with the high seismicity of the Mina area, suggests that strain has already accumulated and is presently being released through inelastic processes. (auth)

23952 SEISMIC SOURCE AND TRANSMISSION FUNCTIONS FROM UNDERGROUND NUCLEAR EXPLOSIONS. Dahlman, O. (Hagfors Observatory, Stockholm). Bull. Seismol. Soc. Amer.; 64: No. 4, 1275-1293(Aug 1974).

A model is presented for the simultaneous determination of the relative variation in transmission properties to different stations and of the relative differences between the seismic sources for closely spaced underground nuclear explosions recorded by a fixed seismological station network. The model is applied to short-period data reported from 24 globally distributed stations from 12 underground nuclear explosions with known yields at the Nevada Test Site. The obtained transmission functions vary within a factor of 10 between the different stations and show a weak decrease with epicenter distance and little correlation with the Gutenberg amplitude-distance curve. The relative source functions for 10 explosions in tuff and rhyolite, with yields in the range 16 to 1200 kt, are with good correlation proportional to explosion yield to 0.9. Two theoretical source-function models, one by Haskell (1967) and one by Mueller and Murphy (1971), are compared with each other and they agree well for frequencies around 1 Hz and for yields in the range 3 to 300 kt. The Haskell model for tuff is modified to be more compatible with the models for salt, granite and alluvium. The Haskell model predicts stronger variation of the source functions with frequency and yield than the Mueller–Murphy model. The observed relative source functions are compared with the theoretical source functions obtained from the two source models. The agreement is fairly good but the relative decrease of the source functions at yields above 300 kt predicted by the theoretical models is not observed. (auth)

23953 P-WAVE ANOMALIES FROM CANNIKIN AT THE INDIAN STATIONS. Srivastava, H. N.; Chaudhury, H. M. (Meteorological Office, New Delhi). Bull. Seismol. Soc. Amer.; 64: No. 4, 1329-1335(Aug 1974).

P-wave travel-time anomalies due to the U.S. nuclear explosion, CANNIKIN in the Amchitka Islands, recorded at 25 stations in India, were studied with reference to the Jeffrey-Bullen (1952) and Herrin et al. (1968) travel-time tables. The results indicated better agreement with the latter tables for this source. (auth)

23954 EQUIPMENT FOR DETERMINING THE DIRECTION OF A NUCLEAR EXPLOSION. Groenhaug, K. L. (to Forsvarets Forskningsinstitut). Norwegian Patent 129,873. 2 Jun 1974. Filed date 11 Jun 1969. 8p. (In Norwegian).

A nuclear explosion generates a transient electromagnetic pulse (EMP) and this may be used to determine the direction in which the location of the explosion lies. Two receiver stations are required, and in the system described each station is equipped with a pulse generator, to which is fed a signal generated by the EMP received. When the strength of the output pulse exceeds a predetermined value the pulse is transmitted to a central register, at which the time interval between the pulses from the two stations is measured, and the direction to the place of the explosion thus determined. In order to reduce the statistical uncertainty innate in such a system each receiver station is equipped with a magnetic antenna connected to the pulse generator through an antenna circuit whose attenuation is such that the strength of the generated signal is mainly determined by the rate of change of the field strength of the signal received. (NO)

Protective Structures and Equipment

Refer also to abstract 24382.

23955 (ARH-ST-104) FINAL REPORT: PROGRAM FOR FIRE PROTECTION, CAVES, CANYONS, AND HOT CELLS. Lee, H. A. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Aug 1974. Contract AT(45-1)-2130. 64p. Dep. NTIS $5.45.

A study of fire characteristics in caves, canyons, and hot cells was conducted; and methods of detecting, extinguishing and containing such fires discussed. A summary of the work done and the results obtained are presented. The purpose of this program was to establish the theoretical and practical basis for providing suitable fire protection systems for nuclear caves, canyons, and hot cells. Its objective was to develop data and information for the design of fire detection and extinguishing equipment and methods for protection of these critical nuclear facilities from fire or the release of radioactive material as the result of fire. The results were used as the basis for a guide which was published at the conclusion of the program. The major areas of investigation were as follows: (1) fire extinguishment, (2) fire detection, (3) protection of filters during fires, (4) effect of ventilation control on fire suppression, (5) effect of radiation on combustion, (6) effect of solvent temperature on the ignition and burning, process, and (7) effect of airborne contamination from burning radioactive solvents. (auth)

23956 (CONF-740807-10) BEHAVIOR OF HIGHLY RADIOACTIVE IODINE ON CHARCOAL. Lorenz, R. A.; Martin, W. J.; Nagao, H. (Oak Ridge National Lab., Tenn. (USA)). 1973. 39p. Dep. NTIS $5.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

The charcoal absorber systems of some nuclear power reactors may contain several tons of charcoal loaded in 2-inch deep trays stacked rather compactly so that the only cooling mechanism of consequence is by forced air circulation. If normal air flow can be obtained when needed, there is no question that the heat from deposited radioiodine can be removed. However, if 25% of the reactor iodine inventory should be released to the containment shell as assumed with some design basis accidents, and further if this amount of radioactive iodine should be collected by the charcoal cleanup system within several hours of reactor shutdown, then calculations show that with severely reduced air flow the ignition temperature might be reached. A series of experiments designed to test whether the ignition of charcoal can occur from the decay heat of highly radioactive iodine before the iodine desorbs, thereby precluding ignition, is described. A second objective of the program is to provide supportive data for the calculation of charcoal bed temperatures. The third objective is to study the movement of iodine within charcoal beds and desorption of iodine from the beds while exposed to high radiation intensity and elevated temperature so that this information can be included in the temperature calculation and in the estimation of radioactivity release. (TFD)

23957 (DP-MS-74-1) HIGH-EFFICIENCY PARTICULATE AIR (HEPA) FILTER PERFORMANCE FOLLOWING SERVICE AND RADIATION EXPOSURE. Jones, L. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 19p. (CONF-740807-7). Dep. NTIS $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

Small HEPA filters were exposed to a ^{60}Co source with a radiation strength of 3×10^{7} rads/h and then exposed to steam-air mixtures at several times filter design flow, followed by extended exposure to steam and air at reduced flow. Additional filters were exposed to air flow in a reactor confinement system and then similarly tested with steam-air mixture flows. The test data and calculated effects of filter pluggage with moisture on confinement system performance following potential reactor accidents are described. Gamma radiation exposure impaired

the performance of new filters only slightly and temporarily improved performance of service aged filters. Normal confinement system service significantly impaired filter performance although not sufficiently to prevent adequate performance of the SRP confinement system following an unlikely reactor accident. Calculations based on measured filter pluggage indicate that during an accident air flow could be reduced ~50% with service-degraded HEPA filters present, or ~10% with new filters damaged by the radiation exposure. (auth)

23958 (DP-MS-74-15) DEEP-BED SAND FILTER AT SAVANNAH RIVER LABORATORY. Moyer, R. A.; Crawford, J. H.; Tatum, R. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). [nd]. Contract AT(07-2)-1. 10p. (CONF-740807-12). Dep. NTIS $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

A deep-bed sand filter was placed in service during June 1974 at the Savannah River Laboratory. This filter provides a back-up for HEPA filters in the primary exhaust system. HEPA filters can fail due to deterioration, faulty seating mechanisms, fire, and/or pressure excursions. The deep bed filter area is 103 feet by 140 feet and consists of layers of rock, gravel, and sand to a depth of seven feet 6 inches. Design flow is 74,000 cfm at 5.15 linear feet per minute. Most of the pressure drop occurs in the 36-in. layer of the "G" sand (sieve size #50 to #30) where the submicron particulates are captured. The filter is described, and operating characteristics are summarized, including pressure drops and filter efficiencies as determined with DOP. (auth)

23959 (LA-UR-74-1035) PERFORMANCE OF MULTIPLE HEPA FILTERS AGAINST PLUTONIUM AEROSOLS. Gonzales, M.; Elder, J. C.; Ettinger, H. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 25p. (CONF-740807-6). Dep. NTIS $4.25.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

Performance of multiple stages of high efficiency particulate air (HEPA) filters against aerosols similar to those produced by plutonium processing facilities has been verified as part of an experimental program. A system of three HEPA filters in series was tested against $^{239}PuO_2$ aerosol concentrations as high as 3.3×10^{10} d/s-m^3. An air nebulization aerosol generation system, using ball milled plutonium oxide suspended in water, provided test aerosols with size characteristics similar to those defined by a field sampling program at several different AEC plutonium processing facilities. Aerosols have been produced ranging from 0.22 μm activity median aerodynamic diameter (amad) to 1.6 μm amad. The smaller size distributions yield 10 to 30% of the total activity in the <0.22 μm size range allowing efficiency measurement as a function of size for the first two HEPA filters in series. The low level of activity on the sampler downstream of the third HEPA filter (~0.01 c/s) precludes aerosol size characterization downstream of this filter. For the first two HEPA filters, overall efficiency, and efficiency as a function of size, exceeds 99.98% including the <0.12 μm and the 0.12 to 0.22 μm size intervals. Efficiency of the third HEPA filter is somewhat lower with an overall average efficiency of 99.8% and an apparent minimum efficiency of 99.5%. This apparently lower efficiency is an artifact due to the low level of activity on the sampler downstream of HEPA #3 and the variations due to counting statistics. Recent runs with higher concentrations, thereby improving statistical variations, show efficiencies well within minimum requirements. (auth)

23960 (LA-UR-74-1051) DESIGN OF VENTILATION AND AIR CLEANING SYSTEMS FOR THE NEW LOS ALAMOS PLUTONIUM FACILITY. Mitchell, R.; DeField, J.; Stafford, R.; McNeese, W.; Eberhardt, W.; Laushkin, N. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 13p. (CONF-740807-11). Dep. NTIS $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

The Los Alamos Scientific Laboratory's new plutonium facility will conform to AECM Appendix 6301-Part II, Section H-Minimum Design Criteria for New Plutonium Facilities. The glove box process exhaust air is filtered through three or four stages of HEPA filters. The design of this multi-stage filter installation is shown with a method of in-place testing of each stage individually. A glove box filter holder and the in-place test procedure is described. General room air from plutonium work areas is recirculated at the rate of eight air changes per hour with a 10% fresh air make-up. The filter plenums for the recirculated air are designed to permit in-place testing of each of the two filter stages. (auth)

23961 (RFP-2213) IN-PLACE TESTING OF MULTIPLE STAGE HEPA FILTER PLENUMS. Linck, F. J.; Geer, J. A. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 1974 13p. (CONF-740807-9). Dep. NTIS $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

Multiple stage high-efficiency particulate air (HEPA) filter plenums are required for plutonium processing facilities. A method used for dioctylphthalate (DOP) aerosol testing in multiple stage plenums at Rocky Flats is described. A brief review is presented on aspects of the plenum design which relate to filter testing. (auth)

23962 (UCRL-75483) HEPA-FILTER SMOKE PLUGGING PROBLEM. Gaskill, J. R.; Magee, M. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jul 1974. 28p. (CONF-740807-5). Dep. NTIS $4.50.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

Actual experiences indicate that during the early stages of a fire, pyrolysis and incomplete combustion of organic materials used in the furnishings or interior finishes of laboratories yield copious quantities of smoke particulates, both liquid and solid. Furthermore, the use of fire retardants in materials used for the above purpose interferes with the combustion process, so that burning of such materials in later stages of a fire will yield dense smoke. These particulates can plug up a HEPA filter or even a more porous prefilter, and thus effectively shut off the exhaust ventilation. In this case, the fire room will pressurize and contamination may spread in an uncontrolled manner. Both small- and large-scale tests have been conducted to evaluate the nature and degree of the problem as a function of materials involved, rate of exposure to the fire, and kinds and temperatures of smokes so generated. Some test work has also been done on scrubbing of smoke. Proposed future work is described. (auth)

23963 SOME ASPECTS OF EQUIPMENT OF RADIOISOTOPE LABORATORIES. Gofman, I. M.; Panfilova, N. P. (Scientific-Research Rentgeno-Radiological Inst., Moscow). Med. Radiol.; 19: No. 8, 38-43(Aug 1974). (In Russian).

The problems of radiation safety of the radiodiagnostics laboratory personnel are as vital as the problems of radiotherapy. The development of a special complex of protective-technological equipment for a radiodiagnostics laboratory is an urgent task of an engineering-physical service of health protection. Investigations showed that in the period of elaboration and industrial mastering of the special complex it is expedient to apply the complex for ensuring the cycle of diagnostic and therapeutic procedures in oncological institutions. (auth)

Vacuum Engineering

Refer also to abstract 25175.

23964 (IPPJ-DT-38) MANUFACTURE OF VACUUM LEAK INDICATOR. Otsuki, H.; Akaishi, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1973. 12p. (In Japanese). NTIS (US Sales Only).

There are two kinds of instruments for examining leak from vacuum equipments, helium leak detectors and mass-filter type gas analyzers. As the second type was adopted for some reasons, a simple linear rf-field acceleration type helium leak indicator was designed, and a leak detector tube was manufactured. In this leak indicator, measured ion synchronizing frequency of 6.18 MHz was obtained, while it was 6 MHz by calculation. A resolution of $M/\Delta M = 7$ was realized. Also, partial pressure sensitivity to helium gas when rf oscillator frequency was fixed at 6.18 MHz was 10^{-3} torr^{-1}. When evacuating speed was changed from 1 l/s to 100 l/s and helium pressure from 10^{-6} torr to 3×10^{-3} torr, the leak detection range was 3×10^{-3} to 3×10^{-1} torr · l/s for the upper limit and 10^{-8} to 10^{-4} torr · l/s for the lower limit. It was found in the above results that this leak indicator fully performs its function for the detection of large leak, in which case helium leak detectors of high sensitivity are inconvenient to use. (JA)

23965 (KHFTI-72-49, pp 34-38) DEVICE FOR STUDIES ON ADSORPTION IN A WIDE RANGE OF TEMPERATURES AND PRESSURES. Milenko, Yu. Ya.; Chernyak, Yu. M.; Kogan, V. S. 1972. (In Russian).

The construction characteristics and circuits of a device for adsorption studies by the volume method in the temperature interval from 4.2 to 300°K are described. The device guarantees extended maintenance of a given temperature. It is designed for isotherm and isochor removal at pressures from 1×10^{-9} up to atmospheric. (tr-auth)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 23748, 23995, 24381, and 26049.

23966 (EPA-660/2-74-038) STATE-OF-THE ART: URANIUM MINING, MILLING, AND REFINING INDUSTRY. Clark, D. A. (National Environmental Research Center, Corvallis, Oreg. (USA)). Jun 1974. 121p. GPO $1.55.

Information is present on: US uranium ore resources and production; U308 requirements to the year 2000; ore processing plants; mining, milling, and refining processes; waste characteristics, waste management; environmental effects of wastes from uranium mining and processing; radiation protection standards; monitoring and testing programs; and technological advances in the uranium industry. Recommendations are made for reducing the concentrations of pollutants released to the environment from the mining, milling, and processing of uranium ores. (LCL)

23967 SODA METASOMATISM AND RADIO-ACTIVE MINERALIZATION IN THE VAESTERVIK AREA, SOUTHEASTERN SWEDEN. Hoeve, J. Amsterdam; Vrije Universiteit (1974). 191p.

Thesis.

The formation of white-colored quartz-plagioclase rocks and their supposed relationship with epigenetic radioactive mineralization of the Västervik area are discussed. The radioactive mineralizations are of two main types, displaying regional zoning. Uraninite mineralizations are exposed in the central portions of a metasedimentary enclave, davidite mineralizations in the marginal portions near the contacts with the bordering Loftahammar augengneisses. Both quartz-plagioclase rocks and radioactive mineralizations originated from one process of hydrothermal alteration, operating during the climax of regional metamorphism. The process of alteration was characterized by the succession of two definite stages: a stage of soda metasomatic leaching and a stage of deposition, during which precipitation took place of material, previously leached from the country rocks. The hydrothermal solutions were generated in close connection with processes of regional metamorphism and palingenesis. Along the fracture system, considerable vertical transport of material has taken place. The exposed lower reaches of the fracture system are characterized by predominance of the stage of soda metasomatic leaching; the higher reaches are characterized by predominance of the stage of deposition. Intermediate reaches are characterized by both leaching and deposition. (NL)

23968 GEOCHEMICAL TRENDS IN THE ALKALI BASALTIC SUITE OF THE ASSAB RANGE (ETHIOPIA). Civetta, L. (Univ., Naples); De Fino, M.; La Volpe, L.; Lirer, L. Chem. Geol.; 13: No. 3, 149-162(Jul 1974).

Two groups of rocks are distinguished in the Assab volcanic range (Afar) on the basis of their petrology. The first one is a typical alkaline suite with high Li, Ba, Rb, Sr, Th, and U concentrations. A second subalkaline group may be related to a parental basalt characterized by low trace-element concentrations and intermediate in character between alkali and tholeiitic basalt. U and Th concentrations of the analyzed Assab basalts, as well as the reported values for the alkali and transitional basalts of the East African Rift and the Afar depression, are higher than values reported for similar basalts from oceanic and continental environments. (auth)

23969 COMPARISON OF ELEMENTAL ACCUMULATION RATES BETWEEN FERROMANGANESE DEPOSITS AND SEDIMENTS IN THE SOUTH PACIFIC OCEAN. Kraemer, T.; Schornick, J. C. (Univ. of Miami, FL). Chem. Geol.; 13: No. 3, 187-196(Jul 1974).

Rates of accumulation of Fe and Mn, as well as Cu, Ni, Co, Pb, Zn, Hg, U, and Th have been determined for five ferromanganese deposits from four localities in the South Pacific Ocean. Manganese is accumulating in nodules and crusts at a rate roughly equivalent to that found to be accumulating in sediments in the same area. Iron shows a deficiency in accumulation in nodules and crusts with respect to sediments, especially near the continents, but also in the central and south-central Pacific. Copper is accumulating in nodules and crusts at a rate one order of magnitude less than the surrounding sediments. This is interpreted as meaning that most of the Mn is supplied as an authigenic phase to both sediments and nodules while Fe is supplied mostly by ferromanganese micronodules and by detrital and adsorbed components of sediments; and Cu is enriched in sediments relative to nodules and crusts most probably through biological activity. (auth)

23970 RADIOACTIVITY IN EARTH'S CRUST. Nishimura, S. (Kyoto Univ.). Seibutsu Kagaku; 25: No. 2, 66-77(Jul 1973). (In Japanese).

As it is necessary to understand the change of radioactivity in the earth's crust in the course of geological time in order to study the relation of the radiation with biological evolution, a summary of various data now at hand which may throw light on this problem is presented. The tabulated or graphic data thus presented concerning the amount of various radioactive elements or nuclides and their disintegration are as follows: grouping of the series of radioactive elements in nature; primary natural radioactive nuclides forming no disintegration series; principal radioactive nuclides resulted from the spontaneous nuclear fission of ^{238}U; main nuclides formed by cosmic ray; forming rate of nuclides at sea-surface by cosmic ray; neutrons formed by cosmic radiation; uranium content in ultrabasic rocks; U, Th, and K contents in igneous rocks; actual or estimated amount of uranium, actinouranium, and radioactive elements of thorium series in ocean; amount of rubidium and strontium in various rocks; U, Th, and K in sedimentary rocks, sediments, and metamorphic rocks; distribution of radioactive elements in seawater and fresh water; radioactive elements in the atmosphere; data on α-, β-, and γ-rays from radioactive elements of various series; data on β- and γ-rays from primary natural radioactive nuclides forming no disintegration series; data on important extinct radioactive elements; data on Xe in standard condition in iodyrite in earth's crust; excessive Xe in CO_2-gas wells; estimated amount of extinct radioactive nuclides in the universe and on the earth 4.5 billion years ago; and changing amount of heat generation in earth's interior by the disintegration of U, Th, K, and principal extinct elements in the course of age. (JA)

23971 OVERVIEW OF URANIUM DEVELOPMENTS IN CANADA. Little, H. W. (Geological Survey of Canada, Ottawa); Williams, R. M. Nucl. Eng. Int.; 19: No. 217, 493-496(Jun 1974).

Past and present production of uranium in Canada is discussed. A map illustrates the uranium deposits and their environments. A few statistics are given for the milling plants, the latest of which is scheduled for production in 1975, and production figures for Canada are compared with those of other states. The marketing of uranium, its present and future exploration, and the part played by the federal government in these activities are discussed. (UK)

23972 U AND Th AS INDICATORS OF FORMATION OF IRON ORE. Syromyatnikov, N. G.; Miroshnichenko, L. A.; Trofimova, L. A. Vestn. Akad. Nauk Kaz. SSR; No. 3, 17-24(Mar 1974). (In Russian).

Data are presented in tables and graphs showing the distribution of uranium and thorium in iron ores and the correlation of the uranium content with the amount of pyrites, for example. (7 references) (auth)

Radioactive Effluents

Refer also to abstracts 23727, 23936, 23988, 23994, 24000, 24028, 24044, 24050, 24366, 24372, 24389, 24813, 24814, 25938, 25949, 25950, and 25990.

23973 (AED-CONF-74-157-003) PRACTICES AND REGULATIONS CONCERNING THE CONTROL OF RADIOACTIVE EFFLUENTS IN ITALY. De Cecco, G. 1974. 9p. INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

6 refs. With abstract.

The technical and administrative problems of control, which public authorities in Italy exercise over radioactive effluents released from nuclear plants, are reviewed. Beginning with the illustration of the qualifying points concerning the environment included in the Italian nuclear laws, the basic criteria at present adopted in Italy for the definition and surveillance of the discharge limits for radioactive effluents are outlined. Finally, a method to define practical reference levels of radioactive contamination in environmental samples collected for surveillance purposes around nuclear sites is described and discussed. (auth)

23974 (DP-MS-74-20) SIMPLE MODEL TO DETERMINE MESOSCALE TRANSPORT OF AIRBORNE POLLUTANTS. Kern, C. D. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). [nd]. Contract AT(07-2)-1. 25p. (CONF-740922-4). Dep. NTIS $4.25.

From symposium on atmospheric diffusion and air pollution; Santa Barbara, California, USA (9 Sep 1974).

Several simple mathematical models used to predict the concentration of tritium diffused and transmitted by the atmosphere from emanations from the Savannah River Plant are described, and model-calculated results are compared with tritium measurements downwind of the source. The models use local meteorological data on wind speed, wind direction, and atmospheric temperature distribution. It was concluded that the model provided better results than straight-line plume calculations and that better formulation of drag coefficients and topography would result in a new model which could provide better mesoscale transport fields of atmospheric pollution concentration calculations. (LCL)

23975 (NP-20111) PRODUCTION AND RELEASE OF RADIOACTIVE KRYPTON- AND XENON-ISOTOPES BY NUCLEAR POWER PLANTS AND REPROCESSING PLANTS AND THE EXPECTED RADIOLOGICAL BURDEN TILL THE YEAR 2000. Hilbert, F. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. Fuer Physikalische Grundlagen der Reaktortechnik; Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Apr 1974. 197p. (In German). Dep. NTIS (US Sales Only) $13.00.

Thesis.

The natural production of radioactive Krypton- and Xenon-isotopes is summarised together with the yields from nuclear facilities and nuclear weapons tests. Specific production rates in nuclear power reactors are calculated. The activity flow in the different plants are described and the consequent release rates, representative of time are evaluated. Estimated release rates from 1500 ton/y fuel reprocessing plants are also included. With the condition that a dose of 30 mrem/y should not be exceeded for any release, the requisite minimum decontamination factors and cooling times are specified. Based on the forecasted growth of nuclear facilities till the year 2000, the time dependent global concentrations and radiation doses from ^{85}Kr releases are calculated using different atmospheric models. The effect of noble-gas separation from the plant off-gas streams in nuclear facilities on the exposure is investigated. (auth)

23976 (WASH-1217-74) CHEMIST-METEOROLOGIST WORKSHOP, 1974, JANUARY 14-18, 1974, FT. LAUDERDALE, FLORIDA. (USAEC Division of Biomedical and Environmental Research, Washington, D. C.; Environmental Protection Agency, Washington, D. C. (USA)). 1974. 61p. Dep. NTIS $5.45.

The four panel discussions held at the workshop are reported. The discussion on technology and environmental impact attempted to pinpoint environmental research activities that must be accelerated as a result of the shifts in energy policy aimed at national self-sufficiency, in particular those associated with the increased use of coal and accelerated nuclear implementation. The panel on precipitation chemistry evaluated areas in which precipitation chemistry couples strongly with human welfare. The panel on long range aerosol formation and transport study focused its attention on the need of an improved aerosol monitoring network. The panel on radioactivity in the atmosphere attempted to categorize various probable atmospheric sources of radioactivity and to evaluate each such source as a hazard, a tracer, or both. (JGB)

23977 ON THE HISTORY OF MEDICAL X-RAY TUBES. Final Part. Prellwitz, F. (Siemens A.G., Erlangen (F. R. Germany). Unternehmensbereich Medizinische Technik). Roentgenpraxis; 27: No. 4, 92-104(Apr 1974). (In German).

13 figs.; with refs. With abstract in German.

A report is given on the development of x-ray tubes for medical purposes—from the gas ions tube to the modern hot-cathode tubes. Especially diagnostic tubes experienced a steep and manifold development, a consequence of the increasing demands for better X-ray images. (auth)

23978 STANDARDS FOR RADIOACTIVE EMISSIONS. Eisenbud, M. (New York Univ., NY). pp 27-45 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (ed.). Springfield, IL; Charles C. Thomas, Publisher (1974).

Topics covered include: how the maximum permissible dose is established, comparison of radiation standards with exposure to ionizing radiation of natural origin, standards of allowable release from reactors, and studies in the environs of operating reactors. (MCG)

23979 ECOLOGIC EFFECTS OF RADIOACTIVE EMISSIONS FROM NUCLEAR POWER PLANTS. Rice, T. R.; Baptist, J. P. (National Marine Fisheries Service, Beaufort, NC). pp 373-439 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

The fate of radioactivity in the environment and radiation effects on the environment are discussed. Radioactive emissions from nuclear power plants; radionuclide migration through terrestrial and aquatic ecosystems, radioecological concentration of isotopes in food chains, and effects of radiation on plants and animals are considered along with interactions with other environmental factors. Protection of man from environmental radiation is also discussed. (MCG)

Radioactivity Monitoring and Transport

Refer also to abstracts 24008, 24009, 24013, 24032, 24038, 24376, 25974, and 25996.

23980 (CONF-730357-1) RADIOISOTOPES IN ENVIRONMENTAL MAINTENANCE. Ljunggren, K. (Isotopteknisk Laboratoriet, Stockholm (Sweden)). 27 Jun 1973. 29p. (In Swedish). Dep. NTIS (US Sales Only) $4.50.

From Norse Atomic Energy Society meeting; Oslo, Norway (7 Mar 1973).

The factors considered in monitoring radioisotopic contamination of the environment are labeling, activation analysis, x-ray fluorescence, radiorelease techniques, measurement values, and irradiation technology. (JSR)

23981 (LA-5633-PR, pp 34-41) ENVIRONMENTAL STUDIES. May 1974.

In annual report of the biomedical and environmental research program.

Progress during 1973 on two research activities, namely, the environmental resources inventory and the radioecological studies, is reported. The characteristics of soil of the waste discharge area are described. The chronic input of low-level radioactive liquid waste into Mortandad Canyon over the last 10 yr has resulted in ^{238}Pu and ^{239}Pu concentrations which are 2 to 3 orders of magnitude higher than corresponding pre-outfall samples. Maximum concentrations in most samples occur within 160 m post-outfall and steadily decline with distance downstream. Concentrations approaching preoutfall levels were measured at distances greater than 5120 m below the waste discharge point. Highest concentrations (~300 pCi/g dry weight) of both plutonium isotopes were observed in sediments. The concentrations of plutonium in sediment core segments to sampling depths of 30 cm were relatively uniform from the effluent outfall to 1280 m post-outfall, where surface water exists at least part of the year. The plutonium in sediment samples beyond 1280 m, where the stream channel is dry, was increasingly concentrated in the top 2.5 cm. There was an apparent distribution relationship between the ^{137}Cs concentrations in the 0 to 2.5 cm layer of post-outfall sediments and the corresponding data for ^{239}Pu and ^{238}Pu. A survey of the plutonium concentrations in soils, vegetation, and rodents was conducted during September 1972 and 1973 along the fallout pathway of the atomic bomb detonated at Trinity Site. Samples were collected from ground zero (GZ) and at 8-km increments out to a distance of about 56 km during 1972. Plutonium concentrations in samples along the fallout pathway were generally highest in the GZ area, were lowest about 24 km from GZ, and then generally increased in all sample types from 24-56 km. Plutonium levels in GZ soils were as much as 10^4 times higher than the 0.01 to 0.1 pCi $^{239}Pu/g$ which has been reported for several New Mexico area soils. A maximum of about 260 pCi $^{239}Pu/g$ was observed at GZ in both the 0-2.5 and 2.5-7.5 cm core segments. The activity ratios ($^{239}Pu/^{238}Pu$) for the 0-2.5 and 2.5-2.7 cm core segments averaged 19 and 18, respectively, while the 7.5-30 cm segment averaged 9. Mean values were about 8-12 for vegetation and 0.5-2.0 for rodent tissues. The significance of the decreasing $^{239}Pu/^{238}Pu$ ratio from soils-to-vegetation-to-rodent tissues is not clear at this time but may indicate that ^{238}Pu in the Trinity environs is more mobile than ^{239}Pu. (CH)

23982 (NERC-LV-539-30) FINAL REPORT OF THE RADIOLOGICAL SURVEILLANCE PROGRAM FOR THE PROJECT GASBUGGY PRODUCTION TEST, MAY 15, 1973 TO NOVEMBER 6, 1973. (National Environmental Research Center, Las Vegas, Nev. (USA)). Aug 1974. Contract AT(26-1)-539. 63p. Dep. NTIS $5.45.

A production test of the Project Gasbuggy nuclear-stimulated natural gas well (GB-ER) was conducted from May 15, 1973, through November 6, 1973. The test well, located about 88 km (55 mi) east of Farmington, New Mexico, had been shut-in for about 42 months since an earlier production test. Data furnished by the El Paso Natural Gas Company indicate that a total of about 49 Ci of ^{3}H and about 4.7 Ci of ^{85}Kr was released into the atmosphere during the flaring of about 3.03 million cubic meters (107 MMCF) of natural gas. Aerial and ground surveillance teams collected environmental samples prior to, during, and after the production test. Samples of air were analyzed for ^{85}Kr, and sam-

ples of atmospheric moisture, vegetation, soil, precipitation, and surface water were analyzed for ^{3}H. Based upon wind patterns and aircraft trackings, samples were collected where the maximum concentrations of these nuclides would be expected to be found. Contaminated water removed from the gas was stored and injected into the flare at higher than normal rates during most of the surveillance operations. Out of 13 compressed air samples collected during the production test, one had a ^{85}Kr concentration (21 ± 1.0 pCi/m^3) which was higher than normal and may indicate a contribution from the production test. Tritium levels above estimated background (1000 pCi/l H_2O) were found in some samples of each type of environmental media collected with the exception of surface water. From the highest concentration of ^{3}H measured in atmospheric moisture samples, it is concluded that any direct exposure to hypothetical off-site receptors was below 0.4% of the Concentration Guide for a suitable population sample in an uncontrolled area. The analytical results of post-flaring sample collection showed concentrations of ^{3}H above estimated background on 10 out of 25 post-flaring vegetation samples that were collected from all four compass quadrants surrounding the flare stack. One of 25 soil samples collected showed a concentration of ^{3}H slightly above the estimated background. There are no guides for vegetation or soil; however, all vegetation samples collected were native uncultivated shrubs which would not constitute additional exposure to the off-site population. (auth)

23983 (PNE-WW-36) ENVIRONMENTAL RADIATION MONITORING FOR PROJECT WAGON WHEEL, 1971–1973. (Eberline Instrument Corp., Santa Fe, N. Mex. (USA)). Jul 1974. 16p.

Radiation monitoring activities conducted from May 1971 to December 1973 in the vicinity of the Wagon Wheel site are described. Samples of atmospheric air, surface and well waters, precipitation, vegetation, soils, milk, sediments, fish, animals, and human urine were monitored. The results of gamma radiation, total alpha, total beta, tritium, ^{40}K, ^{90}Sr, ^{137}Cs, ^{239}Pu, and uranium measurements are tabulated. (LCL)

23984 (SCPRI(RM)-1-1974) REPORT OF ACTIVITY, JANUARY 1974. (Service Central de Protection Contre les Rayonnements Ionisants, 78 – Le Vesinet (France)). 1974. 15p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

Data are presented on the radioactivity in environmental samples collected throughout France during January, 1974. Data are included on radioactivity in atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and T). A monthly bibliographic selection is also presented. (FR)

23985 (SCPRI(RM)-1-1974(Suppl.)) ANNEX TO MONTHLY REPORT, JANUARY 1974. Detail of Results of Measurement. (Service Central de Protection Contre les Rayonnements Ionisants, 78 – Le Vesinet (France)). 1974. 23p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

Tabulated data are presented on the radioactivity in environmental samples collected in France during January, 1974. (CH)

23986 RADIOACTIVITY OF SOME PLANKTON AND SEA-WATER SAMPLES COLLECTED IN THE TARANTO GULF (IONIAN SEA). Triulzi, C. (CISE, Milan); Tassi-Pelati, L. Rapp. Comm. Int. Mer Mediter.; 21: No. 6, 301-303(1972).

Samples from the Taranto Gulf were monitored for fission products, ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{147}Pm, ^{155}Eu, and ^{95}Zr, activation products, ^{60}Co, ^{59}Fe, ^{54}Mn and ^{125}Sb, and natural radionuclides ^{40}K, ^{226}Ra, ^{232}Th, ^{238}U, and ^{234}U. Tables are presented to show radioactivity in pCi/g ash for plankton and in pCi/m^3 for sea-water samples. Data are presented for the Ligurian Sea, Tyrrhenian Sea, Adriatic Sea, and Ionian Sea during 1967 to 1969. (HLW)

23987 ENVIRONMENTAL GAMMA-RAY ANALYSIS. Throckmorton, C. R. Fort Collins, CO; Colorado State Univ. (1973). 235p. University Microfilms Order No. 74-17,551.

Thesis (Ph. D.).

A method of simulating environmental γ spectra obtained with a sodium iodide detector coupled to a multichannel analyzer was developed using Monte Carlo methods. The simulated spectra were used to analyze the unscattered and scattered components of environmental radiation due to the uranium series, the thorium series, and potassium-40. The mean energy, the exposure rate, and the incident flux that produced the observed spectrum were determined from the Monte Carlo data. Thus the method could be used to study the energy response of other environmental monitoring systems and also as an adjunct to interpretation of measurements made by other methods or systems. Monte Carlo spectra of each photon energy of significance in the natural radiation environment were produced in proportion to their frequency of occurrence and summed to produce composite spectra of the unscattered radiation due to thorium, uranium, and potassium in the soil. A model for the scattered radiation component was constructed which assumed the scattered radiation could be approximated by one-Compton scattering before detection. The resulting Monte Carlo spectra were used to analyze actual spectra by comparing the areas under the 2.62, the 1.76, and the 1.46 MeV photopeaks with the corresponding areas in the Monte Carlo spectra. Comparison of areas was also used to infer the scattered contribution to the total spectrum. From these data the exposure rate due to each component could be calculated. Estimations of the cosmic-ray and the very low-energy photon contributions were made. The total exposure rate was compared with ion chamber measurements. This method was shown to be capable of simulating environmental spectra and could be used to approximate the contributions to the spectra from unscattered and scattered radiation incident on the detector. Furthermore, this method yielded good approximations of exposure rate due to, and the energy distribution of, the incident radiation. The method was sensitive enough to detect radiation due to fallout nuclides. (Diss. Abstr. Int., B)

Atmosphere

Refer also to abstracts 23974, 23976, 23989, and 24006.

23988 (AED-CONF-74-157-017) MONITORING OF RADIOACTIVE GASEOUS EFFLUENTS FROM NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Schwibach, J.; Winkelmann, I. (Bundesgesundheitsamt, Neuherberg/Muenchen (F. R. Germany). Abt. fuer Strahlenhygiene). 1974. 32p. INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

3 tabs.; 3 apps.; 4 refs. With abstract.

Monitoring of radioactive gaseous effluents from nuclear power plants must prove that applicable radiation protection standards and licensing conditions are met, that the actual discharge of radionuclide substances may be reported to the public, and that any accidental release of radionuclides may be detected immediately. The total activity of radioactive substances in the gaseous effluents must be determined continuously by direct measurement prior to discharge, whereas radionuclide mixtures or single radionuclides that may contribute significantly to the radiation exposure of the public, even if amounting only to a very minor fraction of the total activity discharged, may be determined separately by continuous or discontinuous sampling and measuring methods, which provide the necessary detection limit. The control of the discharge of radioactive gaseous effluents shall be completed by environmental monitoring in the vicinity of the nuclear power plant. (auth)

23989 (ANL-Trans-959) SAMPLING AND DETERMINATION OF TRITIUM IN THE LOWER LAYER OF THE ATMOSPHERE. Gedeonov, L. I.; Blinov, V. A.; Stepanov, A. V.; Gavrilov, V. M.; Tishkov, V. P.; Maksimova, A. M. (Argonne National Lab., Ill. (USA)). 1973. Translation of SM-180/78. (CONF-731117-7). 11p. Dep. NTIS $4.00.

From symposium on environmental surveillance around nuclear installation; Warsaw, Poland (5 Nov 1973).

Sampling and detection equipment for measuring the tritium concentration in water samples collected from the lower layer of the atmosphere are described. The water content of the air aspirated through the absorbent is adsorbed on predried silica gel with a highly developed hydrophilic surface. After sampling the water in the silica gel is extracted by a stream of hot air circulating in a closed system, from which the water is condensed. The silica gel is regenerated for reuse. The activity of the water condensate is measured by a proportional counter after conversion of the water to H_2. The proportional counter is filled with a hydrocarbon gas and is operated in the anticoincidence configuration. The characteristics of the system are outlined. The development of a scintillation counter for field operation, in which some design and schematic solutions to improve the counting parameters were omitted because of bulk, is briefly outlined. (JSR)

23990 (DPSPU-74-30-5) CONTINUOUS MONITORING OF NOBLE GASES IN REACTOR STACK EXHAUST. Wood, M. B.; Randolph, H. W. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Plant). Jul 1974. Contract AT(07-2)-1. 14p. (CONF-740807-14). Dep. NTIS $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

A system at the Savannah River Plant continuously monitors radioactive noble gases (^{41}Ar, ^{133}Xe, ^{135}Xe, ^{85m}Kr, ^{87}Kr, ^{88}Kr)

discharged to exhaust stacks from each of three heavy-water moderated reactors. A description of the system, calibration technique, and early operating experience are discussed. A flowing sample of stack exhaust air, passing through a 2.8-liter stainless steel sample cell, is monitored for noble gases by a Ge(Li) detector coupled to a multichannel analyzer. Isotopes of noble gases are counted and release data are updated each ten minutes by teletype printout. The system is calibrated by determining the counting efficiency vs gamma energy relationship for both the detector and the sample cell. These relationships are determined with International Atomic Energy Agency standard point sources, National Bureau of Standards ^{133}Xe and ^{85}Kr standard gas sources, and sources containing mixed radioactive noble gases. Accuracy of calibration for the absolute efficiency of the system is ±15% at two standard deviations. Operating experience shows that the system functions reliably and provides useful data on release of radionuclides to the atmosphere. (auth)

23991 (UCID-15509) MATHEMATICAL MODEL USED FOR FALLOUT CALCULATIONS IN THE FALLOUT DISPLAY SYSTEM (FODS). Ferguson, D. E.; Berndt, C. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jun 1969. 17p. Dep. NTIS $4.00.

The mathematical model upon which the fallout calculations for the Fallout Display System are based is described. The assumptions made to simplify the program are listed as well as other sources of error. Plans for future improvement of the model are discussed. (auth)

23992 APPLICATION OF RADON AS INDICATOR OF THE INTENSITY OF EXCHANGES AT THE SOIL (0 to 100 M). Druilhet, A.; Fontan, J. (Univ., Toulouse). Boundary-Layer Meteorology; 6: No. 3-4, 387-411(1974). (In French).

Continuous measurement of radon concentrations at 1.5, 30 and 100 m was carried out for 2 years, from October 1966 to October 1968. The mean diurnal variations of the concentrations are characterized in a simple manner using a Fourier analysis, revealing the diurnal and annual waves, and showing the variations with altitude of the radon concentrations. The amplitude of this diurnal wave can be considered as representative of the mean diurnal variation of the intensity of the vertical exchange processes. This method of analysis is applied to the study of influence of standard meteorological elements measured at the site on the diurnal variation of the exchanges. Additional indicators are derived from temperature, humidity and wind (speed and direction) measurements, and their daily cycles (mean winds, mean direction, temperature diurnal variation amplitude...) are shown to be related to the cycles of radon concentrations. The mean diurnal variations of the radon concentrations classified according to several meteorological parameters are used to characterize the intensity of mixing, in terms of a mixing coefficient. This characterization is achieved both from the average gradients (local value) and from the diurnal wave at the soil. (NL)

Soil

23993 (RFP-2165) ANALYSIS OF PAIRED DATA SEQUENTIAL IN SPACE OR TIME AND THE RELATIONSHIP TO SAMPLING CONTINUOUS CYCLIC DISTRIBUTIONS. Michels, D. E. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 5 Aug 1974. Contract AT(29-1)-1106. 9p. Dep. NTIS $4.00.

Three standard deviations are used to determine what fraction of available information may have been obtained from a set of samples. Discrete data are arranged sequentially in either space or time, and the subject is presumed to exist as a continuous cyclic variable with a continuous trend. The difference between variance for samples of a set and variance for multiple analyses of a single sample define the maximum amount of information obtainable from the set. However, for pairs of samples adjacent in the sequence, variance has an intermediate value. The resolution of the set of samples depends on where the variance for adjacent pairs fits in the range bounded by the other variances. The resolution actually obtained can then be compared with a desired resolution in order to decide whether resampling is required, worth the cost, or whether a new analytical method is needed instead. A procedure for taking composite samples can be based on the cycle length of the continuous variable. Cycle length may be indicated by the standard deviation for adjacent pairs. A worked example problem involves ^{137}Cs fallout in a series of soil samples. (auth)

Water

Refer also to abstract 24305.

23994 (CONF-730596-1) PLUTONIUM FUEL PROBLEM AS IT IS BEING APPROACHED AT SCRIPPS INSTITUTION. Folsom, T. R.; Hodge, V. F. (Scripps Institution of Oceanography, La Jolla, Calif. (USA). Soledad Lab.). [nd]. 18p.

From symposium on the U. S.-U. S. S. R. Marine Water Pollution Committee; La Jolla, California, USA (24 May 1973).

Some of the problems involved in anticipating what will be the fate of plutonium in the marine environment are considered. Problems from background variability, behavior of fallout plutonium in the marine biosphere, chemical properties of plutonium, and monitoring of large-scale oceanic trends of plutonium are discussed. (MCG)

23995 (COO-2185-6) MIXING, DIFFUSION, AND CIRCULATION RATES IN OCEAN WATERS. Annual Report. Broecker, W. S.; Gerard, R. D. (Columbia Univ., Palisades, N. Y. (USA). Lamont-Doherty Geological Observatory). Jun 1974. Contract AT(11-1)-2185. 205p. Dep. NTIS $13.25.

23996 (IAEA-R-871-F) STUDY OF TRACES OF RADIOISOTOPE POLLUTANTS IN THE NORTH SEA AND THE SCHELDT ESTUARY. Part of a Coordinated Programme of Research on Marine Radioactivity Studies. Final Report, 1 February 1970-31 January 1973. Peeters, E. (International Atomic Energy Agency, Vienna (Austria)). Jan 1973. vp. (In French). INIS.

In order to obtain information on the distribution of low-level radioactivity as well as stable counterparts of some radionuclides in seawater and marine biota in the Belgium coast area, multidimensional γ spectrometry was applied to low level measurements of radionuclides and instrumental neutron activation analysis of some trace elements. Determinations of heavy metals in seawater and fish were also carried out by atomic absorption spectrophotometry. The levels of radioactivity were found to be too low to be determined even by this sophisticated counting assembly. The values obtained by atomic absorption spectrophotometry for zinc, copper, iron, chromium, lead and nickel in the coastal areas studied were from 3 to 30 times higher than those reported for uncontaminated seawater. While the content of rubidium, cesium and strontium in seawater was found to be normal in the areas studied, high values were obtained for zinc, chromium, cobalt and mercury by instrumental neutron activation technique. These high values might represent the degree of heavy metal pollution of these coastal areas, although the possibility of contamination during the sampling operations may not be excluded. (INIS)

23997 DISTRIBUTION OF ^{226}Ra IN THE WATERS OF THE EQUATORIAL PART OF THE PACIFIC OCEAN. Kuznetsov, Yu. V.; Lisitsyn, A. P.; Simonyak, Z. N.; Elizarova, A. N. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 709-714(1973).

Translated from Radiokhimiya; 15: No. 5, 704-710(1973).

An investigation was made of the vertical distribution of ^{226}Ra in waters of the equatorial part of the Pacific Ocean. It was found that the mean radium content of this region of the Pacific Ocean is $6.8 \cdot 10^{-14}$ g/liter. The validity of existing hypotheses on the genesis of ^{226}Ra in ocean waters was assessed. It was shown that one of the most important sources of radium in the ocean may be river waters. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 23593, 23979, 24007, 24010, 24260, 24366, 24372, 24389, 24395, 24398, and 24409.

23998 (CONF-740813-1) PLUTONIUM DISTRIBUTION IN LAKE MICHIGAN BIOTA. Yaguchi, E. M.; Waller, B. J.; Marshall, J. S. (Argonne National Lab., Ill. (USA)). 1974. 24p. Dep. NTIS $4.25.

From 17th conference on Great Lakes research; Hamilton, Ontario, Canada (12 Aug 1974).

Samples of plankton, algae, benthic invertebrates, and eight fish species were collected from Lake Michigan during 1972 and 1973. After ashing, the samples were analyzed by radiochemical methods and gamma ray spectrometry for ^{239}Pu, ^{90}Sr, and ^{137}Cs, all of which are components of fallout from atmospheric tests of nuclear weapons. Analyses indicated that ^{239}Pu was scavenged from Lake Michigan water by phytoplankton and attached algae by a concentration factor of up to 10,000. In each of two food chains considered, a progressive discrimination against ^{239}Pu was observed at successive trophic levels: phytoplankton to zooplankton to planktivorous fish to piscivorous fish, and benthic invertebrates to bottom-feeding fish. The benthic invertebrates and fish had somewhat higher ^{239}Pu concentrations than their pelagic counterparts, presumably because of their ingestion of sediments. Ash content was correlated with ^{239}Pu concentrations in samples of plankton and fish. (auth)

23999 (EUR-5063) RADIOACTIVE CONTAMINATION OF FOODSTUFFS IN THE COUNTRIES OF THE COMMUNITY IN

1971. (Commission of the European Communities, Luxembourg). Mar 1974. 66p. (In several languages). Dep. NTIS (U. S. Sales Only) $6.50. EUR FB 85.-.

Data are presented on the radioactive contamination of foodstuffs in the Community countries in 1971 by the radionuclides ^{90}Sr and ^{137}Cs. Tables and graphs illustrate the pattern followed in the course of the year. The average milk contamination for the Community is compared with that of the United States, Canada, the United Kingdom, and Denmark. An estimate is given of the strontium-90 intake by the population. For 1971 this intake averaged 3,513 pCi of ^{90}Sr, which corresponds to 13.2 pCi/gCa in the diet. (auth)

24000 (IAEA-R-960-F) RADIOECOLOGY OF THE KUCUK CEKMECE LAGOON. Final Report, 1 November 1970-31 October 1973. Unlu, M. Y. (International Atomic Energy Agency, Vienna (Austria)). Jan 1974. vp. INIS.

A survey of hydrographical conditions and radioactivity of Kucuk Cekmece lagoon, where the waste effluents from the Cekmece Nuclear Research Center of Turkey are released, was carried out at several stations during the period 1970-1972. Practically no radioactivity except for that due to potassium-40 was observed for organisms and sediments collected. Laboratory experiments on the effects of varying salinity on the uptake of zinc-65 by mussels, Mytilus galloprovinciallis, were performed by labelling mussels with zinc-65 under various salinity conditions normally found in the lagoon. After predetermined time periods, the labelled animals were placed in clean seawater of different salinities to assess the effect of salinity on the outflux of zinc-65. At the same time simultaneous laboratory and field studies on the loss of zinc-65 from mussels were carried out under the natural conditions as well as under laboratory conditions using same water taken from the field. The result of these experiments showed that the zinc-65 uptake of mussels was proportional to salinity over the range of salinities tested. The physico-chemical conditions under which the isotope is accumulated by mussels seem to affect strongly its flux kinetics when the organism is allowed to lose the isotope in an uncontaminated water. Small changes in salinity observed at field stations which could not be adequately reproduced in the laboratory set-up might have accounted for some of the differences observed in the simultaneous field-laboratory loss studies. (INIS)

24001 CHEMICAL CONTAMINANTS IN MILK. Kroger, M. (Pennsylvania State Univ., University Park (USA). Div. of Food Science and Industry). Milchwissenschaft; 28: No. 12, 753-757 (1973).

24 refs.

External chemical contaminants that may enter milk are reviewed. One chapter is concerned with the radionuclides, especially ^{90}Sr, ^{131}I, and ^{137}Cs, which entered the milk formerly mainly due to radioactive fallout. Nowadays the contamination in the vicinity of nuclear power installations is predominant. (GE)

24002 CONTAMINATION OF MARINE TROPHIC CHAINS BY ^{60}Co. Plaices and Crabs fed with Contaminated Arenicola. Amiard-Triquet, C.; Amiard, J. C. (CEN, Fontenay-aux-Roses, France). Rev. Int. Oceanogr. Med.; 33: 49-59(1974). (In French).

A study was made of the passage of ^{60}Co from the Annelid Arenicola marina to the upper trophic level constituted by the Crustacea Carcinus maenas or the Teleost Pleuronectes platessa. The absorption and the fecal, urinary, and branchial excretion of ^{60}Co were measured following the administration of contaminated food during periods from one to five months. The elimination of ^{60}Co by crabs and plaices was monitored for six and three months respectively. Assimilation of radioactive and stable cobalt found as a carrier in contaminated food varied according to the species; assimilation rates were high in C. maenas and very low in P. platessa. Cobalt isotopes were mainly retained in the hepatopancreas of crabs and in the liver and kidneys of plaices. The high concentrations of ^{60}Co in these organs could result in very partial internal exposures but fairly high. They are long-term exposures since cobalt seems to be retained in a hardly exchangeable form. (FR)

24003 RESIDUES IN FOOD OF ANIMAL ORIGIN: AVOIDABLE OR UNAVOIDABLE. Bentler, W. Hippokrates (Stuttgart); 44: No. 3, 243-268(Oct 1973). (In German).

The prevalence of residues of chemical pest controls, radionuclides, heavy metals, trace elements, antibiotics, antiparasitic agents, hormones, sedatives, nitrate and nitrite compounds from food processing, bacterial toxins, mycotoxins, detergents, and disinfectants are discussed on the basis of a bibliographic review and the problems posed by the presence of these residues are considered. (JSR)

Radiometric Techniques

Refer also to abstracts 23968, 24306, 24381, and 25506.

24004 APPLICATION OF TRACER TECHNIQUES TO WATER TRANSFER PROBLEMS. Guizerix, J. (CEN, Grenoble, France). pp 27-34 of Water Pollution. Control, Regulating, Automation, Planning. Paris; Association Nationale de la Recherche Technique (1973). (In French)

From Grenoble, France; 16 Jun 1970 colloquium on water pollution.

Applications of tracer techniques (radioactive, chemical, color and fluorescence) are discussed. Particular emphasis is given to mass transfer problems in relation to the pollution of water with waste materials, thermal pollution, and flood predictions. (FR)

Site Surveys

Refer also to abstracts 23524, 23981, 24017, 24020, 25951, 26003, and 26126.

24005 (DOCKET-701432-5) WESTINGHOUSE RECYCLE FUEL PLANTS. License Application, Environmental Report, Supplement 1. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 19 Jul 1974. 30p. Dep. NTIS $4.50.

Specific questions related to the Environmental Impact Statement prepared for the Westinghouse Recycle Fuel Plant to be located at Anderson, S. C. are asked and answered. The questions involve clarification of impact statement information on the environmental effects of the plant construction and operation activities. (LCL)

24006 (DP-MS-74-19) ACTUAL STANDARD DEVIATIONS OF VERTICAL AND HORIZONTAL WIND DIRECTION COMPARED TO ESTIMATES FROM OTHER MEASUREMENTS. Pendergast, M. M.; Crawford, T. V. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 22p. (CONF-740922-5). Dep. NTIS $4.25.

From symposium on atmospheric diffusion and air pollution; Santa Barbara, California, USA (9 Sep 1974).

Meteorological data were collected near the Savannah River Plant during the periods from May 18 to 30, 1973 and from June to December 1973 and were used to assess the applicability of techniques for determining standard deviations of horizontal and vertical wind direction for 1-h periods. During the 2-week sampling period data were collected at 0.25 intervals. During the 6-month sampling period, data were collected at 5.0s intervals. The results of the data analysis are presented. The magnitudes of the standard deviations are used for the determination of coefficients for the calculation of downwind concentrations of airborne contaminants. (LCL)

24007 (NVO-140(Vol. 1)) ENEWETAK RADIOLOGICAL SURVEY. (USAEC Nevada Operations Office, Las Vegas). Oct 1973. 747p. NVO.

The AEC has conducted a survey in 1973 of the total radiological environment of Enewetak Atoll in order to provide data for judgments as to whether or not all or any part of the Atoll can be safely reinhabited. More than 4500 samples from all parts of the marine, terrestrial, and atmospheric components of the Atoll environment were analyzed by instrumental and radiochemical methods. In addition, an aerial survey for γ radiation levels was conducted over all land areas. Strontium-90, ^{137}Cs, ^{60}Co, and ^{239}Pu are the predominant radioactive isotopes now present, but their distribution is far from uniform. Islands on the southern half of the Atoll from ALVIN to KEITH have levels of contamination comparable to or less than those due to world-wide fallout in the United States. On the northern half, islands ALICE to IRENE are most heavily contaminated, KATE to WILMA are least contaminated, and JANET is at an intermediate level. These radiological data were combined with the best information currently available on the expected diet of the Enewetak people to estimate potential whole-body and bone doses to the population for six living patterns at 5-, 10-, 30-, and 70-yr intervals after return. The main contribution to the population dose comes through the terrestrial food pathway, followed in decreasing order of significance by the external gamma dose, marine, food pathway, and inhalation pathways. In the terrestrial food pathway, the main contribution to both whole-body and bone dose is due to the consumption of pandanus and breadfruit. Percentage contributions to the 30-yr integral dose for each of the terrestrial food items for a population engaged in agriculture on JANET were calculated. It was concluded that corrective actions to reduce population doses will be most beneficial if they are directed at the primary contributors, i.e., pandanus and breadfruit in the diet and external γ dose in the residence areas. (CH)

24008 (NVO-140(Vol. 2)) ENEWETAK RADIOLOGICAL SURVEY. (USAEC Nevada Operations Office, Las Vegas). Oct 1973. 617p. NVO.

A compilation is presented of radiological survey results obtained in 1973 for each of the islands of Enewetak Atoll. The information for each island includes a color aerial photograph, a series of photography overprinted with survey data, and a set of analytical data on ^{239}Pu, ^{90}Sr, ^{137}Cs, and ^{60}Co activities as a function of soil depth at various locations. (CH)

24009 (NVO-140(Vol. 3)) ENEWETAK RADIOLOGICAL SURVEY. (USAEC Nevada Operations Office, Las Vegas). Oct 1973. 687p. NVO.

A compilation is presented of radiological survey results obtained in 1973 for each of the islands of Enewetak Atoll. The information for each island includes a color aerial photograph, a series of photographs overprinted with survey data, and a set of analytical data on ^{239}Pu, ^{90}Sr, ^{137}Cs, and ^{60}Co activities in samples of animals, vegetation, and soils as a function of depth at various locations. Microfiche transparencies reproducing all of the analytical data obtained in the survey are included. (CH)

24010 (NVO-269-21) AMCHITKA RADIOBIOLOGICAL PROGRAM PROGRESS REPORT, JANUARY 1973–DECEMBER 1973. Nelson, V. A.; Seymour, A. H. (Washington Univ., Seattle (USA). Lab. of Radiation Ecology). May 1974. Contract AT(26-1)-269. 101p. Dep. NTIS $8.25.

The Amchitka Radiobiological Program, to collect biological and environmental samples for radiometric analyses, began in 1970 and is continuing. Recent results of analyses include analyses for: γ-emitting radionuclides in air filters, seawater, freshwater, birds, lichens, terrestrial vegetation, marine algae, marine invertebrates, marine fish, sea otter, aufwuchs, and freshwater moss and plants; ^{90}Sr in rats and birds; and tritium in seawater and freshwater. The conclusions from the results are that no new radionuclides are present; the most abundant radionuclides are naturally occurring ^{7}Be and ^{40}K; the trace quantities of fission products, induced radionuclides, and ^{3}H present are from world fallout; and a trace of ^{3}H contamination remains in some Long Shot ponds, as previously reported. It is concluded from the results of analyses of samples collected between September 1969 and December 1973 that there were no radionuclides of Milrow or Cannikin origin in the water, plants, or animals of Amchitka Island. (auth)

24011 (PB-228632) POWER FACILITY SITING IN THE STATE OF ILLINOIS. Part I. Siting Regulation Alternatives. Asbury, J. G.; Hoglund, B. M. (Environmental Technology Assessment, Inc., Oak Brook, Ill. (USA)). Feb 1974. 97p. NTIS $8.00.

For Illinois Institute for Environmental Quality, Chicago.

The current administrative structure for power plant siting in Illinois is summarized, the actions taken by other states are characterized, and several alternatives available to Illinois are discussed. The recommendations advanced would establish a systematic process for planning and siting energy conversion facilities and would expand the responsibilities of the Illinois Commerce Commission in certifying such facilities. The following recommendations were made: that the Illinois Commerce Commission be designated as the state's final and exclusive siting authority; that the utility companies submit annual long-range planning reports to the Illinois Commerce Commission, which will then evaluate these plans; that the utilities file applications for site certification with the Illinois Commerce Commission at least two years in advance of planned construction; and that the applications contain environmental impact statements. (auth)

24012 (PNE-WW-35) ECOLOGICAL CONSIDERATIONS FOR PROJECT WAGON WHEEL. Phase I. Pre-event Biospheric Inventory, Impact Analysis and Mitigation, and Baseline Documentation. Whicker, F. W.; Alldredge, A. W.; Fisser, H. G.; Hanson, W. C.; Johnson, J. E.; Post, G. (Colorado State Univ., Fort Collins (USA); Wyoming Univ., Laramie (USA)). Jun 1974. 298p.

For El Paso Natural Gas Co., Texas.

A pre-event investigation of the ecological consequences of Project Wagon Wheel is reported. The report is divided into seven major parts. Part I is an introductory section which briefly describes the proposed Wagon Wheel Project, the scope and rationale of our investigations, and the approach and methods employed by the team to obtain pertinent information. The general physical, biological, and cultural setting of Project Wagon Wheel is briefly described in Part II. A major effort during the first 18 month phase of this investigation was to compile a detailed and accurate biospheric inventory and analysis which would be applicable to nuclear gas stimulation projects, as well as to other types of activities which may develop in the area. This inventory and analysis, which encompasses natural and cultivated plant communities, aquatic ecosystems, avian and wild mammal populations (including rare and endangered species) and livestock and agriculture, is presented in Part III. Anticipated ecological effects from ground motion, conventional human activities, and radiation expected to result from Project Wagon Wheel are discussed in Part IV. In the event that Project Wagon Wheel is conducted, various studies have been initiated to qualitatively and quantitatively document selected, potential ecological effects. Pre-event documentation data gathered through October 1973 are summarized in Part V, along with recommendations for documentation and observation during and following the event. Some preliminary concepts relative to mitigation of anticipated ecological impacts from Project Wagon Wheel and nuclear gas stimulation technology in general are briefly discussed in Part VI. An overall summary of the investigation to date, including findings and predictions, is presented and discussed in broad perspective in Part VII. (auth)

24013 (WASH-1533(Final)) HTGR FUEL REFABRICATION PILOT PLANT, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TENNESSEE. Final Environmental Statement. (USAEC, Washington, D. C.). Aug 1974. 159p. Dep. NTIS $$11.00.

A final statement is presented on the environmental impact of constructing, operating, and decommissioning of a pilot plant to demonstrate the technology for fabrication of High-Temperature Gas-Cooled Reactor (HTGR) fuel elements from recycled fuel. The pilot plant is to be installed within an existing facility, the Thorium-Uranium Fuel Cycle Development Facility at Oak Ridge National Laboratory in Roane, County, Tennessee, and is scheduled to operate for two years beginning in 1978. Information is included on the Turf facility, the design, operation, and decommissioning of the proposed pilot plant, anticipated benefits, existing environment, environmental impact of regular operating conditions and of accidents, unavoidable adverse environmental effects, alternatives, cost-benefit analysis, safeguards considerations, and irreversible commitments of resources. The environmental impacts and adverse effects from this project are expected to be minor. The gaseous and liquid effluents resulting from operation of the pilot plant will be discharged into existing waste handling and treatment systems. The subsequent concentrations of the radioactive and chemical discharges to the environment will be several orders of magnitude below the established limits and background radiation levels. The solid wastes resulting from pilot plant operation and decommissioning will be disposed of in existing solid waste storage facilities. (auth)

24014 PROCEEDINGS OF THE ENVIRONMENTAL ASSESSMENT AND IMPACT STATEMENTS CONFERENCE, PHILADELPHIA, PENNSYLVANIA, JUNE 13–14, 1973. Saunders, F. A.; Matula, R. A. (ed.). Philadelphia; Drexel University (1973). 195p. (CONF-730695-).

From environmental assessment and impact statements conference; Philadelphia, Pennsylvania, USA (13 Jun 1973).

Conference papers on the content, preparation, and engineering, ecological and socio-economic aspects of environmental impact statements are presented. Five case histories of impact statements prepared for non-nuclear projects are discussed. (LCL)

Thermal Effluents

Refer also to abstracts 24004, 24017, 24027, 24034, 25938, 25950, 25990, 25996, and 26057.

24015 (CONF-740820-1) THERMAL STUDIES ON TROPICAL MARINE ECOSYSTEMS IN PUERTO RICO. Kolehmainen, S. E.; Martin, F. D.; Schroeder, P. B. (Puerto Rico Nuclear Center, Mayaguez). 1974. Contract AT(40-1)-1833. 21p. (SM-187/14). Dep. NTIS $4.25.

From symposium on the physical and biological effects on the environment of cooling systems and thermal discharges at nuclear power stations; Oslo, Norway (26 Aug 1974).

Studies were conducted on zooplankton, micro- and macrobenthos, turtle grass (Thalassia testudinum) beds, mangrove communities and fish fauna in the vicinity of a 310 MW fossil fuel power generating plant that has been operating for two decades. The temperatures in the heated effluent varied from 35°C in the winter to 40°C in the summer, or 10°C above the ambient water temperature. Besides the elevated temperatures, organisms in Guayanilla Bay are exposed to hydrocarbons and heavy metals discharged by the nearby petrochemical and chemical plants. The additional effects of elevated temperatures on the organisms were determined by comparing the communities in the thermal plume to those near the cooling water intake area which has the same chemical pollutants as the plume but does not have elevated temperatures. Results indicated that about 95% of zooplankters were killed in the condensers and in the discharge canal. Further mortality occurred in the plume within 100 m from the mouth of the discharge

canal. At this point the temperatures were still 8°C above the ambient. At ΔT between 1°C and 6°C, species diversity and biomass were higher than at ambient temperatures. This was assumed to be a result of increased nutrient content of water due to the decomposition of killed plankton. During a period when large volumes of water at ambient temperatures were pumped through a new power generating unit, it was observed that most of the mortality was due to the relatively long exposure (14 min.) to the elevated temperatures in the discharge canal rather than the short (4 sec.) exposure in the condensers, or the mechanical damage in the water pumps. Among the meiofauna, the species diversity of foraminifers was lower in the thermal plume than in control areas. Benthic nematodes were nearly nonexistent in the bay, and it appears that nematodes are very sensitive to chemical pollutants while benthic foraminifers seem to be protected against chemicals by their shells. Benthic macroorganisms were not found in areas where water temperature on the bottom was 5°C above the ambient. Turtle grass biomass was lower in the thermal plume than in control areas, but it could not be determined whether this was a result of elevated temperatures or strong water currents. The upper lethal thermal maximum was determined to be between 35° to 36°C. This was done by transplanting turtle grass at different temperatures in the plume. Species diversity and biomass of sessile organisms living on the prop roots of mangroves were not affected below 34°C. Biomass of this community was highest between 6°C and 7°C T and the number of species was inversely related to the temperature above 35°C. In spite of the chemical pollutants, there were more species living on the prop roots in Guayanilla Bay at the control area than in Jobos Bay (on the south coast of Puerto Rico), which is without high levels of pollution. Species diversity of fish in the heated area of Guayanilla Bay was similar to that of the inner, turbid part of Jobos Bay. The number of fish species in the heated area was 28 compared to 53 in the control area. The species most tolerant to elevated temperature were bluegreen algae, mangrove trees, certain molluscs, crabs and fish, all of which had populations living at 37°C or higher. The most sensitive organisms were red and brown algae, coelenterates and echinoderms. Thermal maxima of individual species were 1° to 2°C higher than reported for the same species in the subtropics. (auth)

24016 (CONF-740910-2) IMPACTS OF THE HEAT DISSIPATION SYSTEMS OF NUCLEAR POWER REACTORS UPON THEIR ENVIRONMENT. Nelson, D. J.; Wichner, R. P.; Siegel, S. (Oak Ridge National Lab., Tenn. (USA)). 1974. 4p. Dep. NTIS $3.00.

From 9th world energy conference; Detroit, Michigan, USA (22 Sep 1974).

More than 25 nuclear power plants located in many parts of the US and with different types of cooling systems have been analyzed in compliance with NEPA to determine the environmental impact of these plants. The environmental effects of once-through, closed, or dry cooling tower cooling systems are described briefly with emphasis on once-through cooling systems. (LCL)

24017 (CONF-740922-2) METEROLOGY, COOLING TOWERS, AND ENVIRONMENTAL IMPACT STATEMENTS. Carson, J. E. (Argonne National Lab., Ill. (USA)). 1974. 5p. Dep. NTIS $4.00.

From symposium on atmospheric diffusion and air pollution; Santa Barbara, California, USA (9 Sep 1974).

Alternate wet cooling systems are effective heat sinks, which reduce the impact of thermal discharges on major water bodies. However, they do create their own environmental effects which, for an isolated site such as that required for the exclusion area of a nuclear plant, are rather minor and usually acceptable. Quantitative data on the effects of operation of the various cooling system options are needed so that the utilities and regulatory agencies may accurately weigh the advantages and disadvantages of each and then select the best one for that site. Observations at operating power plants are needed to provide the quantitative information required. The main areas of insufficient knowledge, at least as far as the environmental impact statement preparation and review processes are concerned, are the extent and impact of fogging and icing, plume rise, drift effects, and SO_2-plume interactions that could cause acid misting. Cooling system effects, which may be meteorologically important but are not now major items of controversy, include mesoscale weather changes, critical heat release rates for a given location, consumptive water use, and the spread of pathogens and condensation nuclei. (auth)

24018 (EPA-660/2-74-011) DEMONSTRATION OF THERMAL WATER UTILIZATION IN AGRICULTURE. Berry, J. W.; Miller, H. H. Jr. (Eugene Water and Electric Board, Oreg. (USA)). Apr 1974. 261p. GPO $2.80.

The five-year thermal water demonstration project described was designed to determine benefits and uncover any harmful effects related to thermal water's application in agriculture. The water's temperature approximated that which would be expected from fossil or nuclear power stations and other industrial plants. Benefits were explored in the following areas: frost protection, undersoil heating, greenhouse applications, double cropping, plant cooling, and humidity control. Benefits to agriculture of the water's heat content are described; no detrimental effects were uncovered. (auth)

24019 (EPA-R-2-72-005b) WORKBOOK OF THERMAL PLUME PREDICTION. Volume 2. Surface Discharge. Shirazi, M. A.; Davis, L. R. (National Environmental Research Center, Corvallis, Oreg. (USA)). May 1974. 439p. GPO $4.05.

In a continuing effort to present current knowledge on heated plume prediction to the public, nomograms are presented that describe the behavior of surface jets of heated water for a wide range of ambient and initial discharge conditions encountered in practice. An attempt is made to present the material in a concise manner and in a format that is clear and accessible to a nonspecialist user. The nomograms provide qualitative results describing the surface plume trajectory, width, temperature, depth, surface area and time of travel along the plume centerline. The nomograms are not intended to be used as exclusive design tools for surface discharge problems nor for use in a precise prediction of any specific surface plume condition. The nomograms are generated predominately from an idealized mathematical model of a plume. Some field and laboratory data have been used to adjust the performance of the model so that more realistic predictions are obtained. However, the class of problems that can be handled this way are limited due to the limitations in the model itself. An earnest attempt is made to help the nonspecialist user by pointing out the main restrictions included in the model both in a special chapter in the workbook as well as in example problems. (auth)

24020 (ORNL-TM-4626) TIME-DEPENDENT, TWO-DIMENSIONAL MATHEMATICAL MODEL FOR SIMULATING THE HYDRAULIC, THERMAL, AND WATER QUALITY CHARACTERISTICS IN SHALLOW WATER BODIES. Siman-Tov, M. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 452p. Dep. NTIS $25.75.

Thesis.

A time-dependent, two-dimensional model was developed to provide a practical analytical tool for simulating the transient behavior of the elevation, velocity, and temperature of water and the mass concentrations of various soluble constituents in vertically mixed shallow water bodies. The model is based on a time-dependent discrete element formulation of the basic conservation equations for total mass, momentum, energy, and mass concentration of soluble constituents. These equations are directly formulated in an integral form over each discrete element and then reduced to a set of initial-value ordinary differential equations with respect to time. The equations are numerically integrated by the multistep explicit solution of the Runge-Kutta-Gill method. A stability analysis is presented for evaluation of the time step to be used to avoid computational instabilities. The effects of bottom shear stresses, wind stresses, heat exchange with the atmosphere, Coriolis forces, seepage, evaporation, rain, tributaries, power plant intake and discharge, and other possible contributions are taken account of by the model. Internal normal and shear stresses are included fully in the momentum equations, and hydrostatic pressure is also considered. Turbulent diffusion as well as the longitudinal dispersion caused by vertical variations are taken account of by the use of general functions and nonconstant diffusion coefficients. Density and other physical properties can be expressed as functions of temperature and constituent mass concentrations. Mesh size can be variable, and irregular physical boundaries can be simulated on a rectangular coordinate system. The model is applicable to any natural water body wherein vertical stratification is not of major importance. This includes many rivers, estuaries, and coastal sites where the horizontal dimensions are usually at least two orders of magnitude larger than the vertical (depth) dimensions. The model is basically a far-field model, but because of the incorporation of stresses in the momentum equations, it can also be used for approximate simulation of the near field. The mutual effects of a number of power plants sharing the same water body as well as the recirculation of discharge water back into the intake structure can be simulated. In a more restricted way, the model can also be used to simulate the entrainment of organisms into the intake structure of a power plant as well as the cold shock effects on aquatic biota when sharp discontinuities in power plant operation occur. Because of the capability to include any number of constituents, the model has the potential for extension into a population distribution model for aquatic organisms. (auth)

24021 (ORO-4067-5) THERMAL EFFECTS OF THE SURRY NUCLEAR POWER PLANT ON THE JAMES RIVER, VIRGINIA. Part IV. Results of Monitoring Physical Parameters During the First Year of Plant Operation. Special Report in Applied Marine Science and Ocean Engineering Number 51. Parker,

G. C.; Shearls, E. A.; Fang, C. S. (Virginia Inst. of Marine Science, Gloucester Point (USA)). Feb 1974. Contract AT(40-1)-4067. 473p. Dep. NTIS $10.60.

Waste heat distribution and related phenomena for the James River estuary due to the thermal discharge from the Surry Nuclear Power Plant are documented. Results obtained to date will be compared to those predicted by Pritchard and Carpenter. The Surry Nuclear Power Plant utilizes surface discharge by open-channel flow into the James River. This discharge, due to its free surface nature, is a source of both momentum and buoyancy, spreading vertically, laterally, and longitudinally due to turbulent diffusion and density driven motions. The first unit (822 Mw) of the Surry Nuclear Power Plant began operation December 27, 1972; the second unit (also 822 Mw) began operation in March 1973. Heat distribution and other physical parameters in the study area during the first year of plant operation (1973) are reported and these regimes compared with those of 1971 and 1972. Data taken during plant operation in 1973 indicate higher water temperatures and salinities than in either 1971 or 1972. The slight thermal stratification (approximately 1°F cooler subsurface temperature during May through September) found in the top 6′ of water during the pre-operational period was absent during 1973. In the area of the outfall, water temperatures were directly related to the plant's power production, warmer water tending to remain near the bottom due to the greater salinity, and therefore greater density, of the discharged condenser coolant. Water temperatures in 1973 were less homogeneous than in 1971 or 1972, with "hot" and "cold" spots in several regions in the study area, as well as decidely different isotherm patterns. Isothermal plots of the field data indicate that heat dissipates more rapidly in the plume than predicted by the hydraulic model. (MCG)

24022 (PB-224016) EFFECTS OF TEMPERATURE, RATION, AND SIZE ON THE GROWTH OF JUVENILE STEELHEAD TROUT, SALMO GAIRDNERI. Wurtsbaugh, W. A. (Oregon State Univ., Corvallis (USA)). Jun 1973. 69p. NTIS $6.75.

Thesis.

The effects of temperature, temperature fluctuation, and fish size on the growth of juvenile steelhead trout (Salmo gairdneri) were studied in experiments which lasted 10 to 25 days. Groups of fish were fed at ration levels varying from near-starvation to repletion. Decelerating, curvilinear relationships between rates of food consumption and growth were defined in most of the experiments. At ration levels near maintenance, temperatures raised 3 to 6 C above the seasonal ambient temperatures decreased the growth of the trout. As feeding rate increased, the detrimental effect of temperature growth was ameliorated. At repletion feeding levels, elevation of temperature up to about 17C increased trout growth by increasing the maximum food consumption rates of the fish. Large daily temperature fluctuations of 4 to 8 C did not increase growth rates and in some cases decreased growth rates to levels below those of fish kept at constant temperatures. Periodic sampling of steelhead trout indicated that growth rates of wild trout ranged from −0.18 to 1.6% day. Food consumption rates of wild trout were estimated to range from 2 to 7.6% day considerably less than the maximum consumption rates of laboratory fish. At these food consumption rates it is estimated that stream temperature increases above normal would decrease growth rates of wild steelhead trout. (Selec. Water Resour. Abstr.)

24023 (PB-224059) GROWTH AND FOOD CONSUMPTION OF JUVENILE COHO SALMON EXPOSED TO NATURAL AND ELEVATED FLUCTUATING TEMPERATURES. Everson, L. B. (Oregon State Univ., Corvallis (USA)). Jun 1973. vp. NTIS $6.25.

Thesis.

Relationships between rates of food consumption, growth and food assimilation of juvenile coho salmon were determined for different experimental temperature conditions during the short-term, 30-day experiments. The efficiency of food assimilation was determined by measuring the quantities of food consumed and the amounts of fecal wastes produced. Concurrent long-term studies were conducted over four and eight-month periods under similar temperature conditions. Growth rates of salmon at equivalent ration levels were compared between the short and long-term experiments. The growth rates of control fish were generally greater than those of fish exposed to elevated temperatures for each of the five short-term experiments. Increased rations ameliorated the effects of elevated temperatures on growth rates. The results of the study suggest that temperature criteria for juvenile coho derived from measurements based upon constant temperatures may not be satisfactory for protecting the fish during the extended period of their freshwater existence. Measurements of salmon growth during long-term experiments indicated that any substantial increases of temperature would result in a reduction in the size of smolts. Significant reductions of growth resulting from higher temperatures could influence the production of salmon populations through decreased marine survival. (Selec. Water Resour. Abstr.)

24024 (RT/PROT-(74)10) BENEFICIAL USES OF WASTE HEAT. Ilari, O.; Antonelli, A.; Boeri, G. (Comitato Nazionale per l'Engeria Nucleare, Rome (Italy). Div. Affari Internazionali e Studi Economici). Mar 1974. 52p. (Conf-7210122-1). Dep. NTIS (US Sales Only) $5.50.

From study group on the release of thermal effluents of nuclear power plants and its environmental impact; Vienna, Austria (23 Oct 1972).

The problem of the utilization of waste heat from electric power stations as an alternative method of the direct disposal to the environment is examined. The problem of thermal pollution is particularly relevant in consideration of the foreseeable increase of nuclear power production in the near future; this concern may find a partial solution by means of suitable technologies (cooling towers or ponds); or by the utilization of waste heat for beneficial uses; in this way waste heat is no longer considered as an environmental factor of pollution, but as energy still usable, even through degraded. In the review of the efforts made in some countries with a more developed nuclear industry, different practical cases of applications or plants, for the utilization of waste heat: sewage processing, domestic heating are discussed. (auth)

24025 THERMAL DISCHARGE. Mukai, J. (Ministry of International Trade A Industry, Tokyo). Karyoku Genshiryoku Hatsuden; 24: No. 5, 567-572(May 1973). (In Japanese).

The countermeasures against thermal discharge including regulations against thermal discharge in and outside Japan and the development of energy utilization are described. In Japan, a liaison conference composed of five ministries (Ministry of International Trade and Industry, Environmental Protection Agency, Science and Technology Agency, Economic Council Board and Fisheries Agency) are developing regulations and investigations on thermal discharge. Outside Japan, the IAEA held a panel meeting on Thermal Discharges from Nuclear Power Plants and their Impact on the Environment in order to evaluate thermal discharge problems and their regulation. In England, the regulations on water pollution are applied only to rivers. About 50% of the countermeasures against thermal discharge depends on cooling tower. In the US, 35% applies to the cooling tower method. In the USSR, protection of the public water basin is being proposed. The methods applied include natural or artificial lake cooling and the cooling tower method. Moreover, mathematical models for estimating thermal discharge scattering are being used. The general plan for the investigation of thermal discharges in Japan is shown, and the study system and research funds in each concerned ministry are tabulated. As countermeasures to decrease thermal discharge, the following methods are mentioned: use of deep water in cooling intakes; dilution of thermal discharge; air bubble curtain; discharge into the deep cooling tower; artificial cooling ponds; and discharge into the sea. The utilization of thermal discharge for the fishing industry promotes growth and production of cultured fishes in winter and makes it possible to nurse parent fishes. Thermal discharge is also used for melting of snow and for growing vegetables. In order to promote large scale utilization of thermal discharges in future, the economics of waste heat utilization must be studied. (JA)

24026 METEOROLOGICAL EFFECTS OF COOLING PROCESSES. Caspar, J. W. VDI-Ber.; No. 204, 61-68(1973). (In German).

4 figs.; 13 refs.

Meteorological problems in connection with fresh-water cooling and climatic effects of cooling-tower operation are considered. Fresh-water cooling produces steam plumes that will have no significant influence on the climate. Cooling tower operation in regions with different topological formations, however, may result in marked differences in the vertical temperature distribution of adjacent areas. (GE)

24027 TECHNICAL AND ECONOMIC PROBLEMS ASSOCIATED WITH THE WASTE HEAT FROM THERMAL POWER PLANTS. Krolewski, H. (Vereinigte Elektrizitaetswerke Westfalen A.G. (VEW), Dortmund (F. R. Germany). Hauptverwaltung). Wasserwirtschaft; 63: No. 11-12, 363-371(1973). (In German).

13 figs.; 1 tab.; 10 refs.

Due to the water balance in rivers, there is now a change in the field of cooling systems for power stations in the German Federal Republic. The hitherto most commonly applied cooling with river water is going to be replaced by wet cooling towers in new plants. Besides this, the intensified use of dry cooling systems in the next decade is prepared. This transition stage creates both technical and economic problems. (auth)

24028 HOW TO DEAL WITH THE COLLISION OF INTERESTS. Grawe, J. Umwelt; 4: No. 2, 32-37(Apr 1974). (In German).

1 fig.; 14 refs.

The main problems associated with the unavoidable collision of interests in ensuring future energy supplies and protecting the environment are the following: from the point of view of environmental protection, the emissions of fossil-fuel power plants, especially sulfur oxides, the radiation exposure due to nuclear power plants including the safety hazards, the thermal pollution of rivers by cooling waters, the climatic effects of wet-cooling towers; those arising with regard to further energy needs are the long planning and building times of large power plants and the risks associated with capital investment—especially with respect to site selection—due to the charges and conditions that may subsequently be imposed on the owners or operators of power plants. (GE)

24029 EFFECTS OF THERMAL DISCHARGES INTO SURFACE WATERS. Jensen, L. D. (Johns Hopkins Univ., Baltimore). pp 440-479 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

Waste heat disposal using cooling water systems, mixing and dilution, surface heat dissipation, cooling towers, wet towers, and dry towers is discussed. Biological response to thermal elevation is considered under the topics: ecological range, reproduction and development, optima and extremes, amplitude and duration of exposure, acclimation, parasitism, and dissolved oxygen. Heat additions in lakes, reservoirs, cooling ponds, riverine systems, and estuarine and coastal waters are described. (MCG)

Chemical Effluents

Refer also to abstracts 24028, 24369, 24434, 25950, and 26191.

24030 (UCRL-51614) FURTHER NUMERICAL MODEL STUDIES OF THE WASHOUT OF HYGROSCOPIC PARTICLES IN THE ATMOSPHERE. Stensland, G. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Jul 1974. Contract W-7405-eng-48. 23p. Dep. NTIS $4.00.

Numerical and analytical methods are used to study rainout and washout of hygroscopic particles in the atmosphere. The variation in concentration of hygroscopic material in rain water was investigated as a function of raindrop size class, changing radius of released particles due to drop evaporation, and time from initiation of rainfall. (auth)

24031 (UCRL-75602) SENSITIVITY OF TIME-VARYING PARAMETERS IN STRATOSPHERIC MODELING. Wuebbles, D. J.; Chang, J. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1974. 9p. (CONF-740723-1). Dep. NTIS $4.00.

From 2nd international conference on the environmental impact of aerospace operations in high atmosphere; San Diego, California, USA (8 Jul 1974).

At present there are few models where the effect of time varying parameters such as seasonal and diurnal changes in the solar zenith angle have been studied in detail. In particular, the possible effects on model estimated environmental impact of aerospace operations in the high atmosphere have not been reported in the literature. Using a one-dimensional model we have studied the sensitivity to the time dependent variations of these parameters and its effect on the model predicted perturbations. This sensitivity seems to limit the interpretability of steady state models. (auth)

24032 (UCRL-75603) ONE-DIMENSIONAL MODEL OF PRECIPITATION SCAVENGING. Molenkamp, C. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1974. 14p. (CONF-741016-1). Dep. NTIS $4.00.

From conference on cloud physics; Tucson, Arizona, USA (21 Oct 1974).

The model convective cloud does not efficiently scavenge small particles unless they are initially near or below cloud base and they are active condensation nuclei. But when these conditions are met, precipitation scavenging of toxic materials produces deposition amounts comparable to the amount of toxic material in a vertical column of the undisturbed environment in the vicinity of the convective cloud. (auth)

24033 (UCRL-75902) HAS MAN, THROUGH INCREASING EMISSIONS OF PARTICULATES, CHANGED THE CLIMATE? Ellsaesser, H. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Aug 1974. 24p. (CONF-740921-1). Dep. NTIS $4.25.

From atmospheric-service exchange of particulates and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

Diverse data relating to natural and anthropogenic particulate emissions and trends in atmospheric turbidity are reviewed. It is estimated that man now contributes 13.6% of the 3.5×10^9 tons of primary and secondary particulates presently emitted to the atmosphere annually. Values derived for the anthropogenic effect on the trend in total airborne particulates (if assumed monotonic) range from 0.06 to 0.4% increase per year. Since such an effect would be only marginally detectable in the available record, the much larger rates of increase which have been published as proof of an upward trend must be due to local or temporary effects and cannot be representative of a global trend. On the other hand almost all urban areas plagued by dirty skies prior to the 1940's have shown in recent years measurable improvement in terms of visibility, dust fall, suspended particulates or the ratio of sunshine in the central city to that at an outlying station. This leads to the conclusion that while an anthropogenic upward trend in airborne particulates existed in the past, it was halted and may even have been reversed over the past few decades. (auth)

24034 HEALTH PROBLEMS IN SITE SELECTION OF POWER PLANTS. Campos Venuti, G.; Donelli, G.; Maiani, L.; Pocchiari, F.; Sellerio, U.; Tabet, E. Ann. Inst. Super. Sanita; 9: 79-101 (1973). (In Italian).

Some problems of the power plant siting are discussed. A brief illustration of the biological and physical problems connected with air pollution by power plants is given and some of the rules adopted in Italy and in several other countries are reported. A general scheme for the choice of power plant sites, both from the technical and the bureaucratic point of view, is discussed. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 24866 and 26138.

General Detectors and Monitors

Refer also to abstracts 24134, 24293, 25238, 25870, and 25903.

24035 (AED-CONF-74-042-012) A FAST NEUTRON GAMMA DISCRIMINATOR. Betz, P.; Braun, G.; Hammel, G.; Urban, J. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). 1974. 3p. INIS.

From Spring meeting of the expert committee on nuclear and high-energy physics of the Deutsche Physikalische Gesellschaft e.V.; Bochum, F. R. Germany (4 Mar 1974).

4 figs.; 7 refs. With abstract. Will be published in Nucl. Instrum. Methods.

A fast pulse shape discrimination circuit is described which provides time information within 300 μsec and allows to gate the fast timing signal with the logic neutron or gamma information. (auth)

24036 (AED-CONF-74-044-001) GAS DISCHARGE DETECTORS AS ORGAN CAMERAS IN NUCLEAR MEDICINE. Boehmer, V. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). 1974. 12p. (In German). INIS.

From exhibition and experts' meeting "nuclear technology"; Frankfurt am Main, F. R. Germany (18 Mar 1974).

11 figs.; 2 tabs.; 13 refs.

The paper reviews gas discharge detectors with spatial resolution. The operating mode of the different types (proportional, spark, drift and hybrid chambers) is explained and their possible use for application in nuclear medicine is discussed. (GE)

24037 (BNL-19044) SATURATION CHARACTERISTICS OF IONIZATION CHAMBERS IN THE PRESSURE RANGE A FEW MICRONS TO A FEW MM OF MERCURY. Varma, M. N.; Baum, J. W. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 27p. (CONF-740715-9). Dep. NTIS $4.50.

From 5th international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

Ionization current vs voltage curves were studied at various pressures in a large ionization chamber and in a small mesh wall ionization chamber located within the large chamber. Results indicate that saturation in the internal probe depends on (a) competition between collection in the probe and in the large ionization chamber, (b) recombination at very low voltages, (c) gas amplification at higher voltages, and (d) probe position. Saturation in the large chamber depends on recombination at low voltages and on gas amplification at higher voltages. For both the probe and the large ionization chamber, collection of positive ions proved best; however, saturation voltages had to be chosen carefully at each pressure in order to achieve optimum balance of the above mentioned effects. (auth)

24038 (BNL-19097) ANNUAL REPORT OF THE BROOKHAVEN DCPA CONTRACT GROUP. Greenhouse, N. A. (Brookhaven National Lab., Upton, N. Y. (USA)). Jul 1974. 24p. Dep. NTIS $4.25.

The DCPA Contract Group at Brookhaven National Laboratory was organized in May, 1973, in response to the needs of the Defense Civil Preparedness Agency. Its primary objective has been the development of a dual-use RADEF capability through programs designed to effectively utilize civil defense instrument and manpower resources in response to peacetime radiation accidents. During the past year, the contract group has focused on reactor accident response and the assessment of radioactive effluents in the environment which directly affect public health. Additional efforts were directed at modification of C-D instruments for improved characteristics or to perform special functions, evaluation of RADEF resources in transportation accident response, and the evaluation of DCPA and state RADEF courses for peacetime application. The details of these studies are presented. (auth)

24039 (IEA-323) MAKROFOL AS FISSION FRAGMENTS DETECTOR. Renner, C.; Lourenco, A. P.; Mafra, O. Y. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jan 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

The technique of counting fission fragment tracks through the sparks produced in Makrofol foils has been developed in this laboratory to be used as routine. This kind of detector is being exploited in recent years due to the number of applications they have in nuclear technology and in work connected with fission processes. (auth)

24040 (JINR-13-7218) ELECTRONIC RECORDING APPARATUS FOR THE REPER PROPORTIONAL CHAMBERS. Zanevskii, Yu. V.; Ivanov, A. B.; Mikhailcva, M. N.; Silaev, E. A.; Filatova, N. A.; Chernenko, S. P.; Shirokov, B. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 18p. (In Russian). INIS.

The system of recording electronics for the proportional chamber is described. The apparatus was designed for coordinate measurements and beam diagnostics. The basic technical characteristics of the functional unit are given. The apparatus was developed and fabricated in the high-energy laboratory of JINR. (tr-auth)

24041 (LBL-2657) DEVELOPMENT OF A MULTIWIRE PROPORTIONAL CHAMBER IMAGING SYSTEM FOR NEUTRON RADIOGRAPHY. Valentine, K. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 179p. Dep. NTIS $12.00.

Thesis.

A multiwire proportional chamber was developed for thermal, epithermal, and fast neutron radiographic imaging. It employs electromagnetic delay lines for coordinate readout and solid layer neutron-to-charged particle converters. Thermal neutron detection efficiencies of nearly 4% and spatial resolutions of 2 mm were achieved. Model calculations were in good agreement with experiment and indicate that substantial improvements in both the efficiency and resolution are possible. The value of the neutron sensitive multiwire proportional chamber (MWPC) as a radiographic image detector lies in its ability to image single interactions and to supply coordinate information in a form that is easily digitized for computer storage and processing. Sample radiographs are presented which demonstrate the MWPC's capability for low dose imaging and several examples of computer processed radiographs are shown. Initial work was done with a small (4 × 4.5 cm active area) x-ray chamber which was sensitized to neutrons by the addition of a 3-μm-thick layer of natural boron. The (n,α) reaction on ^{10}B supplied the charged particles necessary for neutron detection. This prototype chamber performed approximately as expected so a larger chamber (25 × 25 cm active area) was designed and built. Enriched ^{10}B converting surfaces were fabricated for thermal and epithermal imaging, and fast neutron imaging was accomplished with a hydrogenous (polyethylene) recoil proton converter. The system's spatial resolving power was determined by Fourier transformation of experimentally measured line spread functions which results in the modulation transfer function. Resolution measurements were made using low energy x-rays (5.9 keV) as well as neutrons. Comparison of the results obtained for the two types of radiation indicates the extent to which the resolving power is limited by longer range charged particles. (auth)

24042 (LBL-3000) LIQUID XENON MULTIWIRE PROPORTIONAL CHAMBERS FOR NUCLEAR MEDICINE APPLICATIONS. Zaklad, H.; Derenzo, S. E.; Budinger, T. F.; Alvarez, L. W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 6p. (CONF-740926-1). Dep. NTIS $4.00.

From 1st world congress of nuclear medicine and exhibition meeting; Tokyo, Japan (30 Sep 1974).

The design and operation of a liquid-xenon gamma camera are briefly described. Images produced by the liquid-xenon camera demonstrate a spatial resolution governed by the wire spacing of ≈3 mm. The dual-phase camera retains the same resolution as a totally filled chamber while the avalanche gain available in the gas is substantially higher. The inability of the dual-phase camera to image on nonhorizontal planes, because of the liquid level requirements, may be overcome by freezing the liquid into a working crystal. It is concluded that proper collimator design and utilization, in conjunction with a high resolution camera, could provide nuclear medicine with the means for significantly improved clinical procedures. (WHK)

24043 (LCA-73-R-121) MEASUREMENT OF NEUTRON FLUENCES USING THE MAGNESIUM SULFATE BATH METHOD. Gelle, M. (Laboratoire Central de l'Armement, 94 – Arcueil (France). Dept. Detection Protection Nucleaire). Oct 1973. 173p. (In French). Dep. NTIS (U. S. Sales Only) $11.75.

The magnesium sulfate bath method was used at LCA (Laboratoire Central de l'Armement) to measure the neutron fluence produced by an accelerator. The method was employed to calibrate a Hanson MacKibben type long-counter between 1.9 and 4.6 MeV. (FR)

24044 (RFP-2218) EMISSION MONITORING SYSTEMS FOR PLUTONIUM FACILITIES. Freiberg, K. J.; Haynes, C. G. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 1974. 10p. (CONF-740807-4). Dep. NTIS $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

The primary purposes of monitoring gaseous effluent are to insure that environmental discharges conform to specified guidelines and to evaluate the performance of the air cleaning system. A system at a plutonium facility is described whose important characteristics are: (1) continuous monitoring with central readout of the amounts of radioactive and chemical pollutants; (2) extensive fixed sample collection; and (3) measurement of the total effluent volume. Also described is a technique for in-service contamination surveys of filter plenums. The system meets the requirements set forth in the "Minimum Design Requirements for New Plutonium Facilities." (auth)

24045 FADING EFFECTS OF ALPHA PARTICLE TRACKS IN CELLULOID FILMS. Yamakoshi, K. (Kyoto Univ.); Hashimoto, K.; Shimamura, T. Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys.; 34: No. 2, 133-138(Feb 1973).

Fading effects of alpha particle tracks by uv radiation and by heating in hot liquids (water, paraffin) and hot air were examined using celluloid films (cellulose nitrate + camphor 25 wt %). It is pointed out that the fading effects of the etched alpha tracks are essentially due to the etching out of the celluloid films. The etched tracks heated in hot air are different from those irradiated by uv radiation and boiled in the hot liquids in two following points: first, the image of the former tracks becomes more undersized and smaller than the ordinary etched tracks, while that of the latter tracks becomes expanded spherically; second, the fading time in which the etched tracks heated in hot air are faded out is considerably long compared to the latter cases. The features of the etched tracks irradiated by uv radiation or boiled in the hot liquids suggest sensitivity enhancement of the celluloid films for ionizing heavy particles and that the boiling process in hot water is the most simple and effective method for it. (auth)

24046 UTILIZATION OF SEMICONDUCTORS IN NUCLEAR PHYSICS. Ruhla, C. (Univ., Lyon). Bull. Union Physiciens; 68: No. 565, 923-930(May 1974). (In French).

The performance of semiconductor detectors used in nuclear physics was studied including surface barrier Si diodes for charged particle detection and Li-doped Ge diodes for x- or γ-ray detection. (FR)

24047 CONSTRUCTION OF SIMPLE PAPER TAPE PERFORATORS FOR RECORDING SCAN DATA. Yasukochi, H.; Tada, S.; Machida, K.; Kumura, F.; Ohshima, M. (Tokyo Univ.). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 1, 33-43(Jan 1974). (In Japanese).

Two kinds of simple controllers for paper tape recording with only several buffer memories which allow direct digital presentation of scintigrams are described. Both apparatuses were composed of sampling circuits, controller, and tape perforator. The sampling circuits were connected to the Toshiba RDA-206-1 scintiscanner to gather the following information: scan start (SS) signal, line start (LS) signals, backline start (BLS) signals, scan end (SE) signal, interval signals, and count signals. The controller has two buffers which have two word memories in each. When one buffer is receiving the counts from the scanner the other buffer is open to the perforator and punches the tape by its memory and then clears the buffer, and after these procedures the following interval pulse changes the circuit of buffers to each other and continues to memorize the count without dead time. The interval pulse is generated with each rotation of the shaft which moves the detector for 5 mm. The apparatus was improved after two years of running and attached to the Nuclear Chicago Pho/Dot III scanner. (auth)

24048 STUDIES ON WHOLE-BODY COUNTERS. I. A New Technique for Uniform Response With Two-Crystal Scanning Method. Okajima, S.; Norimura, T. (Nagasaki Univ.). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 3, 169-178(Mar 1974). (In Japanese).

A low-level whole-body counter was installed at Nagasaki University School of Medicine. Through major efforts described the background radiation was reduced to a very low level and a reasonably uniform response was obtained. This installation is used for measurement of body burdens of natural and artificial radionuclides in humans. Inside dimensions of the room are 260(L) × 140(W) × 210(H) cm with 20 cm thick iron walls. The inner surfaces are lined with 3 mm lead and 3 mm Lucite plate to reduce background count in the low-energy region. The patient is measured mainly on a stretcher with a pair of 8″ϕ × 4″ NaI(Tl) scintillation crystals. Output signals from the crystals are analyzed in a 400-channel pulse height analyzer. The spectrometric resolution (in vivo) is 6.2% in ^{40}K and 9.5% in ^{137}Cs. To obtain a reasonably uniform response the following methods were used: (1) double track scanning method was used to obtain a uniform response even when radionuclides are far from the central axis. A pair of detectors above and below the patient passes down one side and returns on the other, with a distance of 20 to 25 cm between paths. (2) Scanning speed control; the scanning speed is controlled by a program previously prepared to obtain uniform response even if radionuclides are in extreme parts of the body, for example, head or feet. When radionuclides are absorbed in a particular organ and the counting rate increases considerably, scanning speed automatically decreases according to dead time percentage and the dead time loss is corrected. (3) Geometrical mean value is recorded by using two log-rate meters. It is possible to improve the variation of sensitivity when radionuclides are at variable depths from the surface. These techniques gave more accurate measurements than the conventional single scanning method. (auth)

24049 MODEL CONSIDERATIONS ON THE FORMATION OF TRACKS OF IONIZING PARTICLES IN AgCl:Cd CRYSTALS. Schmidt, H.; Haase, G.; Zoergiebel, F. (Technische Univ. Muenchen (F. R. Germany). Inst. fuer Wissenschaftliche Photographie). Ber. Bunsenges. Phys. Chem.; 78: No. 6, 599-601 (Jun 1974).

14 refs.

Doping with $CdCl_2$ desensitizes a pure AgCl crystal for the photographic process. In the doped crystal, an ionizing particle, such as an α particle, sensitizes a narrow core around its path (self-sensitizing). The model presented involves a pre-latent image built up in the core. When the crystal is exposed to yellow light within a sufficient short time after the passage of the particle, electrons are set free from Cd^+ centers in the core ($Cd^+ \rightarrow Cd^{2+} + e^-$), and a real latent silver image is formed by interstitial Ag ions. The particle track is visualized by exposure to blue light, which sets free electrons in the whole crystal. The model considerations are in agreement with experimental observations. (auth)

24050 DESIGN OF ACTIVITY MEASURING INSTRUMENTS IN NUCLEAR POWER PLANT STACKS. Kuhn, L. (Kraftwerk Union A. G., Erlangen (F. R. Germany). Reaktortechnik). Messtechnik; 82: No. 4, 85-90(Apr 1974). (In German).

4 figs.; 4 tabs.; 9 refs.

A survey of the measuring instruments for monitoring the activity in the ventilation stack in nuclear power plants is presented. A measuring device is described which meets the hitherto known requirements imposed by authorities. (GE)

24051 LIQUID SCINTILLATION COUNTING. Blanusa, M. (Inst. for Medical Research and Occupational Health, Zagreb). Arh. Hig. Rada Toksikol.; 25: No. 1, 57-65(1974). (Serbocroatian).

The principles of the liquid scintillation counting method, the most commonly used scintillators and solvents, and the methods of quenching correction are discussed. An attempt is made to briefly review the literature in the field of homogeneous and heterogeneous sample preparation techniques. (51 references) (auth)

24052 SPARK CHAMBER FOR RADIOISOTOPE DIAGNOSIS. Dubrovin, S. A.; Klyuch, V. E.; Shishkanov, N. G.; Novikova, A. F. (Scientific-Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 19: No. 8, 47-54(Aug 1974). (In Russian).

A gamma-topographical unit with a spark chamber as positional-sensitive detector of quanta was designed and manufactured. The design of the spark chamber which operated with the pressure of the working mixture from 760 mm Hg to 3 kg/cm^2 is described. The operating conditions of the spark chamber were determined with the use of an argon-diethylamine mixture in the range of pressures from the normal to 3 kg/cm^2 and xenon-diethylamine with normal pressure. It was shown that resolution of the spark chamber for the range of quantum energy 20 ± 120 keV is within 1 to 3 mm. Calculated and experimental values of complete resolving distance were measured and the efficiency of detection of quanta is given. (auth)

24053 COLLIMATORS FOR LOW ENERGY RADIATION. Zhukova, A. N.; Kalantarov, K. D.; Smirnov, V. F. Med. Radiol.; 19: No. 8, 54-60(Aug 1974). (In Russian).

As a result of investigations of a number of focusing collimators, it is shown that the geometrical radius of the field of vision R (Z) and the values of the curve width of sensitivity function to the linear source of low energy radiation at its half maximum level coincided. Moreover, the mentioned functions in air for focal and near planes are well described by density curves of normal distribution of probabilities. This makes it possible, for geometrical reasons, according to calculated values R (Z) for the predetermined distances from the butt-end of the collimator to the radiation source plane, to predict and plot the modulation transfer functions of the given collimator with an accuracy sufficient for practical use. (auth)

24054 EFFICIENCY OF A NEUTRON DETECTOR BY THE ASSOCIATED PARTICLE TECHNIQUE IN THE T(d,n)^{4}He REACTION. Arriola, H. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis., Suppl. Fis. Apl.; 22: FA51-FA58(1973).

The absolute neutron detection efficiency of an organic liquid scintillator has been measured using a neutron beam whose intensity is measured by an associated alpha particle detector. The experimental data are compared to the theoretical calculations. (auth)

Radiation Dosimeters

24055 (AERE-R-7750) NUCLEAR ACCIDENT DOSIMETRY SYSTEMS: U. K. MEASUREMENTS AT THE THIRD I.A.E.A. INTERCOMPARISON AT VINCA, YUGOSLAVIA, MAY 1973. Delafield, H. J.; Gibson, J. A. B.; Boot, S. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). May 1974. 22p. (CONF-730562-2). Dep. NTIS (US Sales Only) $4.25. UK 50 pence.

From third IAEA nuclear accident dosimetry coordination meeting and intercomparison experiment; Vinca, Yugoslavia (14 May 1973).

Teams from thirteen countries compared their systems for assessing doses in criticality accidents by simultaneously exposing dosimeters to the mixed neutron and gamma radiation field of the Vinča Reactor RB. The Harwell team made measurements both in free air and on phantoms using personnel dosimeters and a threshold detector system. The reactor which produced a heavily moderated neutron spectrum was operated at different power levels for the two irradiations. Surface absorbed doses of 17 and 99 rads due to heavy recoil particles, and 52 and 380 rads due to gamma radiation were measured at the front of the man-phantom facing the reactor in the two respective irradiations. These doses are derived from the personnel criticality dosimeter and film dosimeter gamma measurements. The threshold detector system exposed in a free air position gave values of neutron kerma of 12 and 65 rads in standard man tissue for the two irradiations. Spectra derived from the threshold detector system are also presented. (auth)

24056 (BNL-18963) THERMOLUMINESCENCE OF LiF TLD-100 DOSIMETER CRYSTALS. Fairchild, R. G.; Mattern, P. L.; Lengweiler, K.; Levy, P. W. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 22p. (CONF-740707-11). Dep. NTIS $4.25.

From annual conference on nuclear and space radiation effects; Fort Collins, Colorado, USA (15 Jul 1974).

The unusually complex thermoluminescence obtained from Harshaw dosimeter type TLD-100 LiF crystals was studied with apparatus for measuring emission intensity simultaneously as a function of both wavelength and sample temperature. A separate signal averaged spectrum is obtained at 5.5°C temperature intervals. Data reduction includes all corrections needed to obtain curves of absolute intensity vs. photon energy. Numerous results were obtained from crystals exposed to ^{60}Co gamma-ray doses extending from 5×10^2 to 5×10^7R. All emission spectra could be resolved into Gaussian shaped bands using a computerized best-fit procedure. Below 10^5 R all spectra contain three bands at roughly 3.0, 2.9, and 2.7 eV with full widths of 0.90, 0.72, and 0.96 eV; the precise values vary slightly with temperature. Above 10^5 R additional bands appear at 2.98 and 2.50 eV, and with increasing exposure the 2.9 and 2.7 eV bands diminish in intensity. At doses greater than 4 or 5×10^6R additional bands appear at 4.0, 2.3, and 1.5 eV. In the range usually used for dosimetry, at least the 3 bands at 3.0, 2.9, and 2.7 eV contribute to the thermoluminescence. Glow curves for each of these emission bands were constructed from the resolved Gaussian shaped bands. They contain 8, 3, and 5 prominent peaks. In contrast, glow curves for unresolved spectra contain at least 8 glow peaks, and each peak can contain undetermined contributions from 1, 2, or 3 emission centers. All glow peaks analyzed to date can be fitted by the first-order expression $dn/dt = -ns \exp(-E/kt)$. However, the E and S values obtained for the 190 C peak are too large to be meaningful; thus the kinetics for this peak, and possibly other high temperature peaks, must be complex. To date, thirteen glow peaks have been identified. At low doses the emission is confined to the low temperature glow peaks. With increasing dose the emission intensity increases and progressively shifts to higher temperature peaks. The maximum intensity occurs at 10^6R. At higher doses the emission is reduced but occurs among the highest temperature peaks. (auth)

24057 (COO-1105-209) THERMOLUMINESCENCE IN LiF: USEFUL SENSITIZATION BY PRE-IRRADIATION. Progress Report, July 15, 1973-July 15, 1974. Mayhugh, M. R.; Fullerton, G. D. (Wisconsin Univ., Madison (USA)). [nd]. Contract AT(11-1)-1105. 12p. Dep. NTIS $4.00.

Thermoluminescence has been examined in dosimetry grade LiF after sensitization by either (1) the usual combination, high exposure (10^3 to 10^5 R) followed by annealing near 300°C, or (2) the same treatment but with ultraviolet lamps illuminating the phosphor during the anneal. The second method removes interfering centers and enables application of the increased sensitivity at low exposures, directly reducing the lowest detectable exposure as much as a factor of five, while the first treatment does not. Both procedures alter the phosphor's energy dependence rendering it more nearly tissue equivalent (± 15% above 30 keV eff) at maximum sensitivity (pre-exposure ~10^5 R). Besides high response and better tissue equivalence, sensitized LiF offers the advantages of re-use by annealing near 300°C instead of 400°C, and, as others have noted, an increased range of linearity. The improved sensitivity is stable at least over month long periods, and the ultraviolet technique is practical for treating large batches. (auth)

24058 (KFK-1971) NUCLEAR ACCIDENT DOSIMETRY MEASUREMENTS AT THE THIRD IAEA INTERCOMPARISON, VINCA, YUGOSLAVIA, MAY 1973. Piesch, E.; Burgkhardt, B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). Apr 1974. 37p. INIS.

12 figs.; 21 tabs.; 15 refs. With abstract in English and German.

The Karlsruhe Nuclear Research Center participated in an international intercomparison of nuclear accident dosimetry systems at Vinca, Yugoslavia, organized by the I. A. E. A. Results are presented of dosimeter systems exposed to the radiation of the heavy-water moderated reactor. Dose estimations for free air and phantom irradiations are based on the results of threshold and activation detectors as well as on the activation of the phosphate glass gamma dosimeter used in routine measurements at Karlsruhe. In additional experiments, the dosimetry properties of albedo neutron dosimeters and of a dosimeter belt of polycarbonate were investigated as well as the neutron response of various solid-state gamma dosimeters. The dependence of the detector reading on the direction of the radiation incidence on the surface of a man phantom was studied with threshold detectors, activation detectors and albedo dosimeters. (auth)

24059 (ORNL-TM-4624) FAST NEUTRON MONITORING WITH EXOELECTRON EMITTING BeO DOSIMETERS. Gammage, R. B.; Haywood, F. F.; Lee, M. H.; Cheka, J. S. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 32p. Dep. NTIS $4.75.

Situations in which TSEE dosimeters of ceramic BeO can be used profitably for measuring doses of fast neutrons are exemplified by an intercomparison study with other types of nuclear accident monitoring systems and the measurement of dose profiles with high spatial resolution. The sharply changing directional response for neutrons at an angle of incidence of 90°, and the only slight directional dependence for gamma radiation, is made use of in a cubic device which can serve as a personnel accident dosimeter for determining the orientation of the wearer with respect to the neutron beam as well as measuring the neutron and gamma doses. With disks of Thermalox BeO 995, highly sensitized by heat treatment, neutron doses in the range of 2×10^{-2} to 10^3 rads can be measured. Because the neutron-to-gamma ratio of sensitivities is only about 0.1, the system is of practical use only if the fast neutron dose is at least twice the gamma dose. For repeated use of the BeO detectors, frequent washing in alcohol is advisable to maintain a clean surface. Another difficulty for accurate work is the maintenance of constant detector sensitivity, therefore, recalibration is advisable after using the detectors two or three times. (auth)

24060 DOSE RATE-MEASURING INDICATORS IN CONTROLLED AREAS. Kuhn, L. (Kraftwerk Union A. G., Erlangen (F. R. Germany). Reaktortechnik). Atomwirtsch., Atomtech.; 19: No. 6, 307-309(Jun 1974). (In German).

4 figs.; 7 refs.

Of the dose rate control points in the first German nuclear power plants nearly all were equipped with ionization chamber instru-

ments. In the nuclear power plant Stade also energy compensated counter tubes for dose rate measurement are used for the first time. Here it is to consider that, due to the local variation of the gamma radiation field, the fixed installed instruments can deliver no exact data on the radiation distribution in the observed region. On the contrary, the local dose rate-measuring should give a warning in due course and signal a deviation from the standard condition. At present, a local dose rate-measuring indicator has to meet with the following requirements: the measuring range should be at least $10^{-5}-10^{0}$ R/h and in some special control points even up to 10^{4} R/h. (auth)

24061 EFFECT OF ADJACENT CAVITY ON IONIZATION-CHAMBER MEASUREMENTS IN A PHANTOM FOR 1.25-MeV TO 25-MV PHOTON BEAMS. Golden, R. (Youngstown Hospital Association, Radiation Therapy-South Unit, Youngstown, Ohio 44501); Starchman, D.E. Med. Phys. 1: No. 2, 79-79 (Mar 1974).

Measurements are reported for the Victorian Model 621 high-energy thimble chamber in a solid lucite phantom to determine whether air cavities introduce any errors in the instrument readings. It is concluded that such effects are indeed negligible for the Model 621 chamber. (AIP)

24062 MEASUREMENTS OF ELECTRON-BEAM ENERGY WITH RAPID-PROCESSED FILM. Feldman, A.; de Almeida, C.E.; Almond, P.R. (Department of Physics, The University of Texas System Cancer Center, M. D. Anderson Hospital and Tumor Institute, Houston, Texas 77025). Med. Phys. 1: No. 2, 74-76 (Mar 1974).

A method is described for determining electron-beam energy using ready-packed, rapid-processable film, exposed within a polystyrene phantom.(AIP)

24063 MINIATURE SEMICONDUCTOR DETECTORS FOR THE MEASURING OF IONIZING QUANTUM RADIATION. Dosimetry of Bremsstrahlung. Pfeiff, H.; Bruene, U.; Buss, K.; Pruessner, P. (Fachhochschule Giessen (F. R. Germany). Fachbereich Technisches Gesundheitswesen). Strahlentherapie; 147: No. 3, 242-253(Mar 1974). (In German).

7 figs.; 12 refs.

Dosimetry of high energy radiation by means of miniaturized p-n Si semiconductor detectors is studied. The diodes operated in a voltage-less state show a characteristic behavior according to the theory of the photoeffect on barrier layers. To obtain a dosimeter which marks linearly and independent on temperature, the measuring of the photocurrent is recommended; hereby, an appropriate adaptation of the measuring instruments using the present resistance of the barrier layer must be considered. A semiconductor dosemeter of the described arrangement is easily realizable. The detectors are extremely small and are especially suited for dosimetry in vivo, measurements on models and for the planning and control of therapy. (auth)

24064 ON THE USE OF LiF-7 TEFLON AND TRACK DETECTORS FOR MIXED FIELD DOSIMETRY. Gomaa, M. A. (Atomic Energy Establishment, Cairo (Egypt). Radiation Protection Dept.; Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). Atomkernenergie; 23: No. 3, 161-166(1974).

7 figs.; 8 tabs.; 12 refs.

The two radioactive neutron sources used in the study are the ^{252}Cf and the ^{238}Pu-Be neutron sources. These sources not only emit fast neutrons but also γ-rays. Using the filtered CaF_2 TL dosimeter, the ratio of γ-ray to fast neutron absorbed dose in tissue for ^{252}Cf source is found to be 23%. The sensitivity of the (^{232}Th, 12 μ Makrofol) as fission fragment track detector to ^{252}Cf neutrons is found ro be 4.8×10^{-7} tracks per neutron and the sensitivity of the thin Makrofol to fast neutrons is found to be 6.67×10^{-6} tracks per neutron. The response of LiF-7-0.5 Teflon TL dosimeter to a mixed field of fast neutrons and γ-rays was examined. The response of the lead covered dosimeter to γ-rays is found to be 1.90. The response of the covered dosimeter by 2 mm Lucite is found to be 7% for ^{252}Cf neutrons and 12% for ^{238}Pu-Be neutrons. The response of the same dosimeter to fission fragments is only observed at a neutron flux density of 10^{7} $cm^{-2}s^{-1}$ and the response to ^{252}Cf neutrons is found to be a function of the fast neutron flux density. The same dosimeter shows response to the ^{232}Th fissile foil and the TL induced by 10^{7} alphas/cm^{2} is equivalent to 1.20 rad γ-ray. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 24862.

24065 (AERE-M-2637) HIGH VOLTAGE LABORATORIES HONEYWELL DDP 516. The EBERAS System (Event by Event Recording and Sorting). Part 1. User Guide. Hooton, B. W. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). May 1974. 45p. Dep. NTIS (U. S. Sales Only) $5.25.

The EBERAS system (Event By Event Recording And Sorting) is a special purpose system designed for taking data from four position sensing detectors, which are used in the focal plane of a magnetic spectrograph to determine the energy and radius of bending of charged particles in a magnetic field. A general description is given of the system, followed by sections dealing with the electronics, the use of the DDP 516, and the special test pulse facility. The main part of the Guide deals with the system software, under the following headings: accumulation of data, spectrum directory, display of spectra, spectrum transfer, display expansion facilities, input parameters, particle type selection, magnetic tape manipulation, plotting, spectrum stabilization, data playback and monitoring aids. (UK)

24066 (CEA-N-1704) NEUTRON TIME-OF-FLIGHT TIME INTERVAL CODER. Carnet, B.; Delhumeau, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). 10 Dec 1973. 22p. (In French). (SES-PUB-SEG-73-258). Dep. NTIS (US Sales Only) $4.25.

The C. I. T. M4 time coder provides a binary coded signal of the position in time relative to a time origin. The general principles behind the operation of this device are presented together with its general specifications, a functional description, and a schematic diagram. (FR)

24067 (CNEA-IN-1-116) AUTOMATIC ANALYSIS OF GAMMA-RAY SPECTRA ON SMALL COMPUTERS. Achterberg, E.; Iglesias, F. C.; Jech, A. E.; Moragues, J. A.; Perez, M.; Rossi, J. J.; Scheuer, W.; Suarez, J. F. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 42p. INIS.

A program for the automatic analysis of Ge(Li) gamma-ray spectra is described. Owing to its reduced size it can be used on small (at least 16 K memory words of 16 bits) computers. For the design of the program, the steps of manual methods of analysis have been followed as closely as possible. Most of the subroutines are written in Fortran II language. (auth)

24068 (EPA-660/2-74-045) COMPARISON OF GERMANIUM DETECTORS FOR NEUTRON ACTIVATION ANALYSIS FOR MERCURY. Moore, R. V.; Propheter, O. W. (Southeast Environmental Research Lab., Athens, Ga. (USA)). Jun 1974. 18p. GPO $0.55.

Two types of lithium-drifted solid-state germanium detectors were compared for their ability to detect and measure mercury in matrices of different complexity. A large coaxial detector with relatively high efficiency and a good peak-to-Compton ratio was compared to a thin wafer detector, called a low-energy photon detector (LEPD), which has a good resolution for low energy photons. In samples with relatively few elements primarily of low atomic number, the large detector is preferred because of its greater counting efficiency. In complex samples containing many elements that interfere with the mercury peak, e.g., samarium, thorium, barium, and tungsten, the detector of choice is the LEPD because of its ability to resolve the gamma photons. The choice of detector for intermediate samples would depend on the quantity of interfering elements present. (auth)

24069 (EUR-5047) INVERTED STATISTICAL CHOPPER FACILITY FOR ELASTIC AND INELASTIC NEUTRON SCATTERING EXPERIMENTS. Kley, W.; Matthes, W. (Commission of the European Communities, Brussels (Belgium)). Jan 1974. 36p. INIS.

It is shown that the inverted time-of-flight spectrometer (inverted statistical chopper) has a large accessibility in the K, ω-plane and that the energy resolution function and the intensity is rather constant over a large energy range. The inverted geometry is therefore very favorable to perform precision measurements of line width and line shape of local modes, high energy phonons and magnons. In principle a 4π Be-MgO window detector can be built for high intensity low background experiments. The role of the statistical chopper is primarily to reduce the continuous elastic and inelastic background. All of the results concerning the merits or advantages of a conventional statistical chopper compared to a common time-of-flight spectrometer are as valid for the inverted spectrometer. An inverted statistical chopper facility is a useful and interesting spectrometer for high energy transfer measurements as well as for high resolution powder diffraction work. (INIS)

24070 (HMI-B-131) FIT-COMPUTER PROGRAM FOR MOESSBAUER SPECTRA. Morfeld, U. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kernchemie und Reaktor). Mar 1974. 21p. (In German). INIS.

1 fig.; 2 tabs.; 3 refs.; with app.

A computer program for the evaluation of Moessbauer absorption spectra measured in the "time mode" is described. The The relative motion between source and absorber is assumed to be either sinusoidal or with constant acceleration. The absorption lines are fitted to Lorentz curves. (GE)

24071 (IAE-2231) USE OF THE PSEUDORANDOM METHOD FOR NEUTRON PULSE SOURCE SPECTROMETRY. Muradyan, G. V.; Pevzner, M. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 12p. (In Russian). INIS.

The possibility of combining the classical method of time-of-flight neutron spectroscopy with pseudo-random time-of-flight spectroscopy is analyzed. It is shown that for many experiments such a combination gives more precise measurements. (tr-auth)

24072 (JAERI-M-5556) STUDY ON THE ANALYSIS OF GAMMA-RAY SPECTRA WITH A Ge(Li) DETECTOR. Sasamoto, N.; Koyama, K.; Tanaka, S. (Japan Atomic Energy Research Inst., Tokyo). Feb 1974. 44p. (In Japanese). NTIS (US Sales Only).

A code has been prepared to analyze 5.25 gamma-ray spectra from Ge(Li) detectors using a fitting technique by the nonlinear least squares method. With the code, the successive steps of analysis can be performed from peak searching on the estimation of gamma-ray peak areas, peak locations, and the errors. From the results of analysis with the code, it was found that to obtain meaningful solutions in gamma-ray spectra analysis the full width at half maximum (FWHM) should contain three channels or more and the separation between peaks be larger than half the FWHM for analysis of a complex spectrum consisting of two peaks. Validity of the analysis method was tested by analysis of the gamma-ray spectra from Ta and W. (auth)

24073 (JEN-281) CALIBRATION OF A NE213 DETECTOR FOR NEUTRON SPECTROSCOPY. Blazquez Martinez, J.; Butragueno Casado, J. L. (Junta de Energia Nuclear, Madrid (Spain)). 1974. 39p. (In Spanish). Dep. NTIS (US Sales Only) $5.00.

The experimental procedure for the calibration of a NE213 detector with a beam of neutrons from the J.E.N. 2-MeV Van de Graaff is described. The detector has been used for measuring the spectrum of the fast reactor CORAL-1. There is also included an experimental method for finding the Compton edge on the electron spectrum. (auth)

24074 (JINR-P13-8026) SEMICONDUCTOR β-SPECTROMETER OF HIGH ENERGY RESOLUTION. Vasil'ev, S. K.; Vylov, Ts.; Osipenko, B. P.; Yurkovskii, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 19p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A spectrometer with Si(Au) and Si(Li) detectors was designed at the Laboratory of Nuclear Problems (JINR) intended for study of conversion electron spectra and low-energy γ-quanta. The energy resolutions of 900 and 440 eV were obtained for the electron energy ~30 keV (decay of ^{161}Eu) and for γ-ray energy ~12 keV (decay of ^{241}Am), respectively. (auth)

24075 (KFKI-74-51) SIMULATION OF THE PEAK PILE-UP DETECTION. Tarnay, K. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1972. 16p. Dep. NTIS (US Sales Only) $4.00.

The number of peak pile-up pulses was determined by simulation programs for an ideal pile-up detector and for a finite time resolution detector. These programs can furnish information on the appropriate choice of input rise time and the pile-up detector time resolution according to the measuring task thereby enabling the spectrum-distortion from pile-up effect to be plotted. (auth)

24076 (KFKI-74-52) SINBAD PROGRAM PACKAGE. Tarnay, K. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). [nd]. 44p. Dep. NTIS (US Sales Only) $5.25.

The SINBAD program package simulates the operation of analog-to-digital converters and contains 10 programs written in ALGOL. The characteristics of the program package are discussed, and the user specification of every program is given. (auth)

High Energy Physics Instrumentation

Refer also to abstract 25253.

24077 (EFI-31-73) CERTAIN POSSIBILITIES OF PARTICLE DETECTION BY MEANS OF TRANSITION RADIATION. Lorikyan, M. P.; Shikhlyarov, K. K.; Yaralov, V. Ya. (Erevanskij Fizicheskij Inst. (USSR)). 1973. 18p. (In Russian). INIS.

Different forms of detectors of x-ray transition radiation, particularly streamer chambers with porous radiators, were examined. Sandwiches from streamer chambers and porous radiators were also examined. The particle rejection factor was discussed as a function of the level of discrimination with respect to the number of photoelectrons. A 4 π detector of transition radiation with porous radiator and filmless data extraction was also examined. (tr-auth)

24078 (JINR-1-7307) ELECTRON DETECTOR IN EXPERIMENTS WITH K^0-MESONS. Birulev, V. K.; Vovenko, A. S.; Grigalashvili, T. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 23p. (In Russian). INIS.

A detector consisting of shower counters with complete absorption of the sandwich type and designed for selection of $K^0_{2\pi}$ decays in experiments on the regeneration of neutral kaons was described. The characteristics of the detector obtained on an electron beam and by means of secondary particles from kaon decay are reported. The detector was constructed in the high-energy laboratory of the JINR. (tr-auth)

24079 (JINR-10-7192) PROGRAM SECTIONAL SYSTEM FOR FILM PROCESSING ON THE BESM-6 COMPUTER. Buzdavina, N. A.; Dorzh, L.; Ivanov, V. G.; Lepilova, L. I.; Lukyantsev, A. F.; Zaikina, A. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 14p. (In Russian). INIS.

The program sectional system for processing film data from the liquid hydrogen chamber on the BESM-6 computer was examined. The system consists of RAM files containing standard processing programs and their basic modifications. (tr-auth)

24080 (JINR-10-7303) PROGRAMS FOR DISCRIMINATION OF STRAIGHT TRACKS RECORDED WITH SPARK CHAMBERS. Govorun, N. N.; Ivanov, V. V.; Ivanchenko, I. M.; Kuznetsov, V. N.; Senner, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 16p. (In Russian). INIS.

A description is given of the algorithms and programs for the discrimination of straight tracks. The programs were written for the BESM-4 computer in the "Assembler" self-code and formulated in the form of standard programs in the IS-2 system. The averaged time characteristics for the operation of the program and the efficiency of the discrimination are given. (tr-auth)

24081 (JINR-10-7343) PROGRAM FOR SAMPLING PRELIMINARY IMAGES FROM HYDROGEN CHAMBER MEASUREMENT DATA RECORDED ON THE MAGNETIC TAPE. Slepnev, S. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 7p. (In Russian). INIS.

The PREMIST program for the preparation of input data for the MIST program is described. Data stored on the magnetic tapes of the TRA-1001 computer on preliminary measurement of images subjected to processing by the scanning HPD, were selected and used for preparation of the input magnetic tape for the MIST program. The capacity of the program, for the SDS-1604A computer is about 200 entries of the event projection type per minute. (JSR)

24082 (JINR-13-7006) RECORDING BLOCK FOR MULTIWIRE PROPORTIONAL CHAMBER. Silaev, E. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 13p. (In Russian). INIS.

A 4-channel assembly for recording information for a multiwire proportional chamber, based on the ECL integral micro-diagram, is described. Each channel consists of an amplifier, a checking arrangement, and a memory with gating recording and plotting. The assembly has a fast output. Results are given of tests made on the assembly with a simulator of the signals of a proportional chamber. The assembly was made at the JINR High Energy Laboratory. (tr-auth)

24083 (JINR-13-7265) 1×1 m^2 MAGNETOSTRICTIVE SPARK CHAMBER. Zanevskii, Yu. V.; Peshekhonov, V. D.; Pugachevich, V. P.; Shirokov, B. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 8p. (In Russian). INIS.

The fabrication and operating characteristics of the spark chamber with dimensions of 1×1 m^2 and with magnetostriction readout are described. The electrical wiring diagram of the chamber is discussed, and the results of bench verification of the chamber efficiency are given. (tr-auth)

24084 (PB-227936/2) COAXIAL AND PRINTED CIRCUIT DELAY LINES FOR MULTIWIRE PROPORTIONAL CHAMBER READOUT. Boyd, D. P.; Rand, R. E.; Rothbart, G.; Barth, E. (Stanford Univ., Calif. (USA). High-Energy Physics Lab.). Mar 1972. 12p. (HEPL-667). NTIS $4.00.

From 13th scintillation and semiconductor counter symposium; Washington, D. C. (1 Mar 1972).

Delay lines have been shown to offer many advantages for multiwire proportional chamber readout, particularly in applications involving single event counting. It is desirable to optimize the delay line with respect to cost, mechanical convenience, linearity, and risetime. Several types of tapped delay lines have been constructed and have been tested with a 20 × 20 cm proportional chamber. A delay line constructed of 100 1 meter lengths of RG-316/U miniature coaxial cable offers excellent linearity (<.2%), a rise time of 30 nsec, and total delay of 500 nsec. Printed circuit delay lines, with characteristics similar to the coaxial lines were constructed, and offer greatly improved packaging properties at a cost of less than $1 per wire. (auth)

24085 (RL-74-038, pp IV.1-IV.31) COMPUTING TECHNIQUES FOR A SPARK CHAMBER EXPERIMENT. Wickens, F. (Birmingham Univ., Eng.). Mar 1974.

An introduction is given to the computing techniques used in the design and analysis of a typical high energy physics experiment using spark chambers and counters. The first part of the lectures covers some basic techniques which are required at several stages of an experiment. The second part considers the various stages of an experiment in something like the order they normally occur. (LBS)

24086 (RL-74-047) HIGH ENERGY ELECTRON SELECTION BY MEANS OF X-RAY TRANSITION RADIATION. Bateman, J. E. (Science Research Council, Chilton (UK). Rutherford Lab.). Feb 1974. 27p. Dep. NTIS (U. S. Sales Only) $4.50.

The availability of ~2.5 XTR photons per particle from fast electrons (≥3 GeV/c) traversing a radiation of ~1000 plastic foils promises good electron detection efficiency. Experiments have been performed to see if an electron selector with good aperture, angular acceptance and pion rejection factor can be fabricated from such a radiator followed by a MWPC x-ray detector. The problem of rejecting particles not accompanied by x-rays is approached through the technique of pulse shape analysis. It is found that while selection can be achieved, the presence of delta rays and the physical processes of x-ray detection effectively neutralize the possibility of useful pulse shape discrimination in this context: the solution to the problem appears to lie in the increase of the XTR flux by the use of materials of very low atomic number, i.e., lithium. (auth)

24087 ANGULAR DISTRIBUTION MEASUREMENTS OF SECONDARY-PARTICLE FLUXES WITH SPALLATION DETECTORS AND COMPARISONS TO HADRON CASCADE CALCULATIONS. Routti, J. T. (Helsinki Univ. of Tech.). Nucl. Sci. Eng.; 55: No. 1, 41-50(Sep 1974).

A method is described for measuring angular distributions of momentum-integrated secondary-particle fluxes from high-energy accelerator targets by studying gamma-ray spectroscopically spallation reactions induced in foils placed around the targets. Results obtained for different threshold energies at 15- to 165-deg angles with copper foils at 22 GeV/c at the CERN Proton Synchrotron are presented. They are further interpreted with the aid of calculated spallation cross sections and compared with good agreement to the results of Monte Carlo computations of hadronic cascades. (auth)

24088 ACCEPTANCE FUNCTION OF A MAGNETIC COSMIC RAY SPECTROGRAPH. Basu, P. S.; Nandi, B. C. (Regional Engineering Coll. Durgapur, India). Proc. Indian Nat. Sci. Acad., Part A; 39: No. 3, 185-193(May 1973).

An important parameter in any magnetic cosmic ray spectrograph is its acceptance function and its variation with magnetic deflection or momentum of the particle. A method has been described to determine this acceptance function which has been applied to find out its value in the arrangement of the Durgapur Cosmic Ray Spectrograph (DUCOSP). (auth)

24089 REFRIGERATING SYSTEMS FOR THE BIG CERN BUBBLE CHAMBER. Giger, U.; Pagani, P.; Trepp, C. (Winterthur Engineering Works Division, Switzerland). Sulzer Tech. Rev.; 56: No. 2, 54-60(1974).

A combined helium-hydrogen refrigerator has been installed for cooling the new CERN bubble chamber at Geneva. The cooldown of the bubble chamber and magnet as well as emergency operation and control of the refrigerator are described. Besides the choice of basic conception and circuit, the plant components are dealt with too. The function of the bubble chamber and the development of the CERN proton synchrotron are described in order to facilitate understanding of the relationship between the Sulzer cryogenic plant and the CERN bubble chamber. Installations and equipment not manufactured by Sulzer are also mentioned. (auth)

Radiometric Instruments

24090 (BFL-2/1974) THE USE OF RADIOMETRIC INSTRUMENTS TO DISTINGUISH CHERRIES WITH AND WITHOUT STONES. Frank, A. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (F. R. Germany)). 1974. 39p. (In German). INIS.

8 figs.; 2 tabs.; 3 refs. With abstract in German and English.

Experiments were carried out to determine the value of radiometric instruments in taking measurements of piece goods, in this case, cherries. The aim of this work was to develop an instrument capable of sorting cherries with stones from those without stones. General rules and conditions for radiometric instruments operating in the range of soft gamma-rays were developed. A machine with electronic evaluation for sorting cherries is described. (auth)

24091 (INT-35/1) MEASUREMENTS OF DENSITY PATTERNS OF HYDROMIXTURES BY MEANS OF RADIOMETRIC SCANNING METHOD. Michalik, A. (Institute of Nuclear Physics and Techniques, Krakow (Poland)). Oct 1972. 8p. (In Polish). INIS.

Results of research carried out on the industrial hydraulic installation are presented. Density patterns have been measured by means of a radiometric scanning method. Density distribution of the flowing mixture was measured under following conditions: mean flow velocity $\bar{v} = 4.0 \pm 10\%$, mean density of the flowing mixture was regulated from 1.10 to 1.90 g/cm^3. Preliminary analysis of about one hundred density patterns of the measurements performed is presented. (auth)

24092 A RECORDING RADIOMETRIC GAGE FOR THE COMBINED MEASUREMENT OF EMISSIONS OF DUST AND RADIOACTIVITY IN AIR. Dresia, H.; Mucha, R. (Essen Univ. (Gesamthochschule) (F. R. Germany). Fachbereich Verfahrenstechnik – Kerntechnik). Staub-Reinhalt. Luft; 34: No. 4, 125-128(Apr 1974). (In German).

11 figs.; 4 refs.

In the case of the radiometric dust measuring method, when using a ^{14}C-beta-radiation source and an end-window counter, such a high measuring accuracy can be achieved that a measuring cycle of about one hour is possible under normal dust concentration in the air. By transient screening of the β-source the air activity deposited on the filter is measured in the same cycle. Measuring errors due to the moisture of the filter and sample are essentially reduced by preheating the air to about 90°C. Finally, the emission values measured in a town district are described. As a result of short measuring cycles the typical maximum values could be determined more clearly. (GE)

24093 ADVANCES IN RADIOMETRIC PROCESS CONTROL OF MATERIALS IN THE FORM OF WEBS, STRANDS, AND STRIPS. Kosmowski, A. (Frieseke und Hoepfner G.m.b.H., Erlangen (F. R. Germany)). Verfahrenstechnik.; 7: No. 8, 229-233(Aug 1973). (In German).

6 figs.; 6 refs.

This article deals with new applications of absorption measurements adopting non-contacting infra-red and isotope techniques. Examples of the application of the infra-red double-ray principle (for moisture content and plastics coatings) and the treble-ray method (for moisture content and weight per unit area of paper and for the concentration of solvents) are described. Details are given of radiometric process control and other applications in the paper, board, and plastics industries. (GE)

24094 MEASURING CAR FOR RADIOISOTOPE EXPERIMENTS AT USER'S SITE. Wiss., Wirt., Polit.; 4: No. 8, 9 (Feb 1974). (In German).

Description of a measuring car with which different radioisotope measurements can be carried out, as e.g., velocity measurements using labelled compounds, mass transfer measurements with tracer techniques, and weight and density measurements using transmission as well as backscattering methods is presented. (GE)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 24783.

24095 (AD-772546/8GA) EFFECTS OF IONIZING RADIATION ON GALLIUM ARSENIDE PHOSPHIDE METAL-INSULATOR-SEMICONDUCTOR STRUCTURES. Kuhlmann, G. J.; Grannemann, W. W. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Aug 1973. Contract N00014-68-A-0158. 109p. (EE-213(73); ONR-005). NTIS $4.50.

MIS capacitors were fabricated on n-type GaAs0.5P0.5 using a thermally grown chromium-doped insulator and chromium gate electrode. The fabrication procedures which lead to stable devices are described. The devices were exposed to both ^{60}Co gamma rays and high-energy electrons. A qualitative model which relies on carrier injection and trapping in the GaAsP disordered region is proposed to explain the observed radiation-induced space charge buildup in the capacitors. Radiation-induced increases in the fast interface-state density were generally less than 15 percent of the pre-irradiation values and were found to be independent of radiation type and dose, as well as the gate bias applied during irradiation. Thermal annealing experiments show that the radiation-induced charge can be completely annealed at a temperature of 150 C, independent of the gate bias applied during annealing. (auth)

24096 (AD-774633/2GA) INVESTIGATION OF RADIATION EFFECTS ON QUARTZ CRYSTALS AND OSCILLATORS. Final Scientific Report. Halperin, A.; Levinson, J.; Braner, A. A.; Zloto, D.; Nahir, J. (Hebrew Univ., Jerusalem (Israel)). Jul 1973. 30p. (AFCRL-TR-73-0592). NTIS $4.50.

Effects of electrical sweeping and of 5-MeV electron irradiation on quartz resonators are described. The infrared absorption bands in the 3 micrometer range were examined, and the temperature dependence of a few lines in crystals that contained Li^+, Na^+ or H^+ was found to give activation energies of about 0.1 eV. The currents during electrolytic diffusion at 500 C were found to be almost independent of the thickness of the sample down to thicknesses of 0.5 mm. In a prolonged diffusion experiment in which K^+ ions were introduced into a quartz crystal, the resonator ceased oscillating, presumably because of an uneven distribution of the K^+ ions in the crystal. The effects of electron-irradiation on the Q-values and frequencies of quartz resonators were examined in various experiments, both during and after the termination of the irradiation. Preirradiation of a resonator was found to improve its behavior on further irradiations. (auth)

24097 (AD-775987/1) IONIZING NOISE IN INFRARED SENSORS. Vickers, V. E.; Shepherd, F. D. Jr.; Burke, E. A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 13 Dec 1973. 15p. (AFCRL-TR-73-0750; AFCRL-IP-207). NTIS $3.00.

A model is described for the effects of gamma-induced ionizing noise in infrared sensors, taking into account the incident gamma spectrum, both Compton events in the detector and secondary hot electrons from the metal surroundings, partial or total deposition of the initial hot electron energy, detector geometry, and preamplifier impulse response. The model as coded gives predicted pulse height distributions and, for threshold-gating type circumvention, predicted duty cycles; it indicates that detector volume should be minimized. Good agreement with experimental results is achieved. (auth)

24098 (AD-776026/7) STUDY OF ELECTRONICS RADIATION HARDNESS ASSURANCE TECHNIQUES. Volume I. Background, Approach, and Summary of Results. Final Report, 31 July 1970–16 July 1973. Arimura, I. (Boeing Co., Seattle, Wash. (USA)). Jan 1974. Contract F29601-71-C-0001. 150p. NTIS $4.75.

The results of a comprehensive study which was designed to determine improved techniques for providing radiation hardness assurance on modern electronic systems are presented. The two basic goals considered were (1) to determine from physical reasoning and large-scale testing the effectiveness of established electrical screening parameters and the existence of additional ones which might be correlated with radiation responses, and (2) to establish a statistical comparison between the various hardness assurance techniques including electrical screening, lot sampling and irradiate-and-anneal. (GRA)

24099 (AD-776027/5) STUDY OF ELECTRONICS RADIATION HARDNESS ASSURANCE TECHNIQUES. Volume III. Lot Sampling and Irradiate-and-Anneal. Final Report, 31 July 1970–16 July 1973. Arimura, I. (Boeing Co., Seattle, Wash. (USA)). Jan 1974. Contract F29601-71-C-0001. 200p. (AFWL-TR-73-134-VOL-3). NTIS $5.50.

The program determined physical failure modes of a range of discrete and integrated semiconductor devices exposed to ionizing rate, neutron, and total dose environments. The efficacy of lot sample radiation testing was evaluated using transistors with traceability as far back as the wafer position. In addition to studying homogeneity at a wafer level and between wafers, the variability between diffusion runs was assessed. Base transit time normalization for the low-power transistors reduced the measured variability in neutron damage across the wafers, and between diffusion lots. These results establish the existence of a reasonable degree of homogeneity for the low-power devices studied. Inhomogeneity of surface effects at wafer and diffusion levels was established for the transistors used in this task. Irradiate-anneal (IRAN) for parts subjected to neutron and total dose environments was evaluated. Neutron IRAN for the power transistor was found to be an effective technique as determined by the predictability of the neutron induced-gain degradation. Total dose IRAN was effective for the OP AMP used, but inadequate for the sense AMP which was extremely hard. (GRA)

24100 (AD-776064/8) INVESTIGATION AND DESIGN OF ELECTRONIC CIRCUITRY RELATED TO NOISE AND RADIATION EFFECTS FOR SOLID STATE DEVICES AND CIRCUITS. Final Report, 1 November 1970–31 October 1973. Cochrun, B. L.; Salmon, P. C.; Clark, J.; Greiling, P. T. (Northeastern Univ., Boston, Mass. (USA)). 1 Dec 1973. Contract F19628-71-C-0052. 42p. NTIS $3.25.

Investigations of the problems of noise related to devices and/or circuits and the design of noise reduction circuits are described. Two methods are described for coping with noise pulses associated with detector post amplifiers. One approach is to gate off the post amplifier. The other involves elimination of the noise pulse using a cancellation technique. An improved gating circuit, over that using MOSFET's, uses operational transconductance amplifiers, OTA's. Analog delays for processing purposes use MFD active filters having low sensitivity factors for passive components. An optical signal and random noise source was designed for noise-signal simulation. The "edge" effect associated with Schottky-barrier diodes was investigated and a phenomenological theory proposed by planar theory. Included is a brief study of the effects of radiation on IMPATT diode characteristics. (auth)

24101 (SAND-74-5244) HARDENING QUARTZ RESONATORS TO IONIZING RADIATION: A REVIEW. King, J. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 18p. (CONF-740632-2). Dep. NTIS $4.00.

From international conference on evaluation of space environment; Toulouse, France (17 Jun 1974).

Accumulated performance data on the stability of quartz resonators in earth orbiting satellites, as well as similar information gained from deep space probes, underscore the importance of reducing the effects of ionizing radiation on these critical system components. The phenomenological response of precision AT-cut resonators to both steady state and pulsed radiation is briefly reviewed. The resultant frequency offset and change in resonator Q have been interpreted in terms of radiation-induced changes in certain point defects in the quartz crystal structure. These defects involve interstitial monovalent cations which can be removed by solid diffusion along the optic axis at elevated temperatures in the presence of an electric field. High Q precision resonators fabricated from such "swept" quartz exhibit an extraordinary insensitivity to ionizing radiation relative to untreated quartz. (auth)

24102 (SAND-74-8622) EFFECTS OF RADIATION ON THE ABSORPTION AND LUMINESCENCE OF FIBER OPTIC WAVEGUIDES AND MATERIALS. Mattern, P. L.; Watkins, L. M.; Skoog, C. D.; Brandon, J. R.; Barsis, E. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 78p. (CONF-740707-12). Dep. NTIS $7.00.

From annual conference on nuclear and space radiation effects; Fort Collins, Colorado, USA (15 Jul 1974).

Irradiation of fiber optic waveguides with x-rays, gamma-rays, electrons, or neutrons can cause luminescence and losses in optical transmission. These effects have been measured, using pulsed and continuous radiation sources, in bulk materials and in most commercially available fiber bundles. Some important effects of dopants and impurities such as Ge, Ti, Fe, Al, and OH on radiation-resistance have also been determined. Transient absorption and luminescence were measured from 10 ns to 0.1s after irradiation (10 to 10^6 rads and 10^9 to 10^{13} rads/sec), and the permanent absorption was measured from 24 to 72 hours after irradiation (10^3 to 10^9 rads). These results show that synthetic vitreous silica (undoped), some doped silicas, polymethylmethacrylate, and polystyrene can be used in radiation environments that are encountered in space and military applications. The utility of each of these fibers depends on the particular radiation environment, the length of waveguide, the wavelength of signal light, the time any system can be "off the air," and constraints

imposed by fiber cost. The data can be used to determine the response of actual fiber systems during and after irradiation. (auth)

24103 (SLA-74-5349) RADIATION HARDENING TECHNOLOGY. Gregory, B. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 4p. (CONF-741013-1). Dep. NTIS $4.00.

From 146th meeting of the Electrochemical Society; New York, New York, USA (13 Oct 1974).

The radiation tolerance of semiconductor structures is influenced both by physical design and by processing details. For example, physical design determines the neutron tolerance of bipolar devices, while processing details determine the tolerance of MIS structures to ionizing environments. Neutron and ionization effects on a variety of silicon semiconductor devices are discussed, and how design and processing can be altered to improve radiation tolerance is indicated. (auth)

24104 RADIATION EFFECTS IN LIGHT PIPES AND LIGHT PIPE ISOLATORS. Blake, K.; Epstein, A.S.; Polimadei, R.A.; Share, S. (Harry Diamond Laboratories, Washington,D.C. 20438); Snyder, J.F. Appl. Opt. 13: No. 6, 1272-1274 (June 1974).

Radiation effects on individual components of a light pipe isolator are reported. The isolator is made up of a fiber-optic light pipe, a GaAs 900-nm light emmiting diode and a silicon PIN photodiode detector. The devices were exposed to radiation from a ^{60}Co source in steps to a total dose of 10^8 rads (Si). (AIP)

24105 INCREASED RADIATION HARDNESS OF GaAs LASER DIODES AT HIGH CURRENT DENSITIES. Barnes, C.E. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 45: No. 8, 3485-3489 (Aug 1974).

Total light output of GaAs laser diodes has been measured at 300 and 76 °K before and after successive neutron irradiations to a cumulative fluence of 6.5×10^{14} neutron/cm^2 (>10 keV). The range of current densities used extended from well below the laser threshold current density to the maximum allowable value. Both the subthreshold light output and the threshold current density were sensitive to neutron damage in agreement with previous observations. However, at current densities significantly above threshold the light output is much less sensitive to irradiation and, in fact, the light output at 76 °K was observed to increase following irradiation. These latter results have significant practical importance for cases in which laser diodes must operate in a radiation environment. (auth)

Miscellaneous Instruments

Refer also to abstracts 24177, 24628, and 25877.

24106 (IAE-2219) MULTI-PARAMETER RECORDING SYSTEM ON THE BASIS OF AN ANALYZER AND A DISTANT DIGITAL COMPUTER OPERATING IN THE INTERRUPTION REGIME. Vinogradov, A. A.; Kurashov, A. A.; Malygin, A. V.; Paramonov, V. V.; Pasynkov, I. G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 12p. (In Russian). INIS.

Variants in the use of the memory in a nonintegrating, operational regime for multi-parameter experiments are considered. Block diagrams and programs are presented for two formats. The principles and block diagrams of information readout are described, and the need for an extinguishing regime with recording of data by light pencils is explained. A number of exchanges with the M-220 computer are discussed in a discontinuous evaluation of the "Dispatcher" program. The advantages of the recording system are emphasized. (tr-auth)

24107 (JINR-10-7325) SYSTEM FOR DIGITAL OUTPUT ON THE DIGIT PRINTING AND THE PUNCHED TAPE IN THE CAMAC SYSTEM. Belyakova, M. P.; Nguen Fuk; Urmanova, L. A.; Khmelevski, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 11p. (In Russian). INIS.

A system for the digital output of data on the digital printout and punched tape in the CAMAC system is described. The system consists of a model for the conversion of the binary code into the binary-decimal code, a decimal indicator, printing interface, perforation interface, and program control. (tr-auth)

24108 (JINR-13-6892) SHIFTED SQUARE PULSE GENERATOR FOR INTEGRATED CIRCUITS. Yanik, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 6p. (In Russian). INIS.

A block diagram and the principal circuits of the shifted pulse generator are described. The generator was constructed of transistor and integral circuits. The generator has the following characteristics: amplitude of the output pulse is 3.5 V; length of the output pulse is 30 nsec; frequency repetition is 10^2 to 1.6×10^7 Hz; time displacement in parallel channels is 100 nsec to 5 msec. (tr-auth)

24109 (JINR-13-7056) 12-INPUT MAJORITY COINCIDENCE CIRCUIT WITH DIGITAL SELECTION. Basiladze, S. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 13p. (In Russian). INIS.

A rapid 12-input majority coincidence circuit with digital selection of events in multiples from 1 to 4 is described. The scheme has a gating prohibition entrance and is made completely of integrated circuits with emitter bonds. The equipment was developed and constructed in the New Scientific Developments Department. (tr-auth)

24110 (JINR-P3-7147) ELEMENTARY THEORY FOR THE METHOD OF DETERMINATION OF THE ELECTRIC DIPOLE NEUTRON "MOMENT" USING UCN. 1. "Pass" Variant. Taran, Yu. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 20p. (In Russian). INIS.

Two types of spectrometers for the electric dipole moment of neutrons are compared—the first a beam type using cold neutrons and a storage type using ultracold neutrons. The spectrometer of the latter type was examined in two variants—circulating and storage. The elementary theory of electric dipole moment spectrometers in the circulating variation with supply of the oscillating magnetic field by the Rabi and Ramzeya methods is discussed. The great sensitivity of the installation in the Ramzeya method is shown. Minimization of the errors in the measurement of the electric dipole moments by geometric dimensioning of the input and output apertures is reported. Formulas are given for their optimum cross section. (tr-auth)

24111 (LBL-3063) SINGLE PHOTOELECTRON TIME SPREAD MEASUREMENT OF FAST PHOTOMULTIPLIERS. Leskovar, B.; Lo, C. C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1 Jul 1974. Contract W-7405-eng-48. 61p. (CONF-740719-1). Dep. NTIS $6.25.

From conference on precision electromagnetic measurements; London, UK (1 Jul 1974).

Time spread measurements, using single photoelectrons of fast photomultipliers having dynodes with cesium-activated gallium-phosphide secondary emitting surfaces were investigated. Measurements of the time spread, made by means of a specially developed measuring system with improved time resolution capabilities, on several 8850's and C31024's are presented and discussed. Critical evaluation of the measuring system is given, particularly concerning the influences of the light pulse width and the constant fraction discriminator timing errors on the system time-resolution capabilities. The measuring system incorporates a subnanosecond light-pulse generator capable of operating at a repetition rate of 3 MHz with output light pulses having a full width at half-maximum of less than 200 psec. It also incorporates a constant fraction discriminator which has a time walk less than ±35 psec over a range of input-pulse amplitudes from 35 mV to 8 V. The optimum operating conditions of the photomultipliers have been determined for minimum time spread and relative collection efficiency. The error of the time spread measurements, because of the finite width of the light pulse, is discussed and determined for different pulse widths. (auth)

24112 (RFN-2-73) CONSTRUCTION OF A CHARGED PARTICLE AND LIGHT CHOPPER TO PRODUCE PULSED BEAMS. Saplakoglu, A.; Onay, I. (Ankara Nuclear Arastirma Merkezi (Turkey)). Jun 1973. 7p. (In Turkish). INIS.

A multipurpose mechanical chopper was designed and constructed to produce a pulsed beam of equal time intervals of alpha or beta particles produced by radioactive sources or ion sources, as well as light beams. A metal sheet containing two slits is rotated at any desired speed up to 10,000 rpm. The first slit produces a "start" pulse by a light beam passing through it. Its height and polarity is designed to suit the start pulse requirement of the "time of flight unit" of the multichannel analyzer. The second slit can be cut out at any desired shape depending on the experiment to be performed and interrupts the beam at adjustable equal intervals to produce bursts of charged particle beams. (INIS)

24113 (UCID-15545) VTAB: A PASSIVE IMPULSE GAGE. Comfort, W. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1969. 14p. Dep. NTIS $4.00.

A new passive gage for impulse measurement in a nuclear environment has been developed which can be made to have an approximately linear calibration curve, has an unusually large measuring range, and is analytically predictable. The gage is a cantilever beam with a sample attached to the free end. The

impulse is received on the sample and its magnitude is indicated by how much the beam is bent as a result. By increasing the width of the beam linearly, starting at the fixed end, the calibration curve of impulse versus angle of bend can be made nearly linear rather than having the parabolic shape characteristic of many passive impulse gages. The fixed end bends over a curved anvil of known radius which serves two purposes: (1) it defines the maximum strain in the beam so that the ultimate strain is not exceeded, and (2) it causes plastic bending to occur over some distance, rather than at a point, so that the response is more predictable. A single gage can be designed so that its measuring range is 15 to 20 times its threshold value. An associated computer code, VTAB, is used to calculate design parameters for the gage and predict its response. The code can predict gage response to within better than 10 percent. Experimental calibrations of the gage to check the predicted response are made with a magnetic flyer plate. (auth)

24114 400 RAD FLASH X-RAY SYSTEM FOR PULSE RADIOLYSIS. Hinsch, H.; Scheel, H. E., Niemann, E. G. (Institut fuer Strahlenbotanik der GSF, Hanover). Rev. Sci. Instrum.; 45: No. 5, 650-652(May 1974).

The design and working principle of a flash x-ray system is described. A two-stage Marx generator is used; the charging voltage is 150 kV, the stored energy 1125 J. The anode and cathode are arranged coaxially. The anode consists of a tungsten coated aluminium tube of 20 mm i.d. into which the substances to be irradiated are placed. Measurements of electrical and radiation parameters are described. The x-ray dose per pulse is 400 rad, the half-width of the pulse is 0.2 μsec and the mean quantum energy 44 keV. An example for the application of the system in microsecond pulse radiolysis is presented. (auth)

24115 APPARATUS FOR NEUTRON DIFFRACTION AT HIGH PRESSURE. McWhan, D. B. (Bell Telephone Labs., Inc., Murray Hill, NJ); Bloch, D.; Parisot, G. Rev. Sci. Instrum.; 45: No. 5, 643-646(May 1974).

Powder neutron diffraction data have been obtained on cesium metal above the two transitions at 42.5 and 43 kilobar using a piston cylinder apparatus. A Lucalox cylinder (high density Al_2O_3) (35.4 mm o.d., 6.35 mm i.d.) is radially supported by compressing two steel plates with a hydraulic ram leaving a neutron window between the plates ~6 mm high. A 17° included angle was used between the cylinder and support plates. A tungsten carbide piston, driven by a second hydraulic ram, raised the pressure on the sample at three times the rate of increase of the support pressure. (auth)

24116 TROMBAY AUTOMATIC DIFFRACTOMETERS: A 3-DIMENSIONAL FULLY AUTOMATIC NEUTRON DIFFRACTOMETER. Momin, S. N.; Sequeira, A.; Chidambaram, R. (Bhabha Atomic Research Centre, Bombay). Indian J. Pure Appl. Phys.; 12: No. 2, 121-128(Feb 1974).

The design and construction of a fully automatic four-circle neutron diffractometer installed at the CIRUS reactor are described. The three counter and crystal orientation angles 2θ, χ and ϕ (and if necessary, the fourth angle Ω) can be set to an accuracy of 0.01°. Information on the setting of angles, direction of motor movement, etc. punched on paper tape prepared by the CDC 3600-160 A computer is read, processed and stored in uniselectors and relays. The instantaneous position of the various shafts driven by 360 : 1(for $2\theta,\chi,\Omega$) or 180 : 1 (for ϕ) worm gears is sensed by optical digitizers and stored in reversible five-decade counters. Each motor stops after coincidence between the corresponding counter and the uniselector store is achieved. The step-scanning of a reflection, with the teleprinter printout of signal counts following each step, starts when all the angles have been set; after scanning over the specified range of 2θ, the tape reader starts reading the data for the next reflection. The average time spent for setting and scanning a reflection is about half-an-hour. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstract 23615.

24117 (CTC-INF-1077) URANIUM ENRICHMENT ACTIVITY (UEA) SIMULATOR. Oran, F. L. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 31 May 1974. Contract W-7405-eng-26. 28p. Dep. NTIS $4.50.

Given annual existing GDP complex separative capacities or power levels, demands, feed availabilities, and operating parameters, the model computes and reports feed and separative work balances (including feed purchases and new plant separative work, if required) around both the GDP plant itself and the Uranium Enrichment Activity (UEA) complex. The model also reports the schedule of feed usage on a yearly basis and by feed assay and the feed and separative work contents of the demands by both transaction and operating tails assays. (auth)

24118 (KFK-1986) GASDYNAMIC OPERATING CHARACTERISTICS AND CRITERIA OF INHERENT STABILITY OF SEPARATION NOZZLE CASCADES FOR U-235-ENRICHMENT. Schuette, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Kernverfahrenstechnik; Karlsruhe Univ. (TH) (F. R. Germany)). May 1974. 63p. (In German). INIS.

19 figs.; 19 refs. With abstract in German and English.

The operating characteristics of separation nozzle cascades for the enrichment of U-235 have been investigated experimentally in a ten-stage separation nozzle pilot plant. Numerical computer programs have been established to simulate the operating characteristics of the pilot plant with sufficient accuracy. These computer programs are used for the advance calculation of industrial cascades involving large numbers of stages and technical components which cannot be implemented in a pilot plant. The operation of the pilot plant has shown that, with a sufficient degree of inherent gasdynamic stability, a trouble-free enriching operation is assured in separation nozzle cascades which use a process gas mixture of uranium hexafluoride, with a high percentage of an additional light gas. Essentially the gasdynamical behavior is characterized by local confinement of steady-state disturbances which affect only a small number of adjoining stages, and by the fact that transients between steady-state modes of operation follow an asymptotic course. For simple forecasting of the stability qualities of industrial separation nozzle cascades, the methods of digital computer simulation have been complemented by an approximate analytical method for the computation of gas dynamic cascade transients and for the calculation of stability properties. This approach allows the effects of arbitrary cascade disturbances to be described by means of an operations point diagram showing the transient course of stage pressure P_0 and UF_6 concentration N_0 in the stages of a cascade following a steady-state perturbation or the removal of the cause of the perturbation. On the basis of this method, the analytical formulation of the criteria of inherent stability allows a detailed analysis of single gas dynamic properties of the different cascade components to be performed with respect to their impact on the cascade stability. In this way it is possible to influence very specific properties of cascade components and thus obtain any desired degree of cascade stability. The application of this method in the investigation of the components of the pilot plant and the industrial prototype separation nozzle stages actually in operation is discussed. (auth)

24119 (UCRL-74904) SOME APPROACHES TO PHOTOCHEMICAL AND PHOTOPHYSICAL SEPARATION OF ISOTOPES. Axelrod, T.; Bernhardt, A.; O'Leary, T.; Marling, K.; Keeler, R.; Wood, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jul 1973. 14p. (CONF-730821-6). Dep. NTIS $4.00.

From international conference on magnetism; Moscow, USSR (22 Aug 1973).

A brief discussion of some apparently practical approaches to separation of isotopes of elements of technological interest is presented. Most of these techniques involve the exploitation of the extremely high spectral intensity ("brightness") and extensive frequency tunability available from state-of-the-art lasers. Single examples of cases in each of several of the more obvious categories are given. (auth)

24120 URANIUM ENRICHMENT. Maekawa, F. (Central Research Inst. of Electric Power Industry, Tokyo). Karyoku Genshiryoku Hatsuden; 24: No. 5, 523-528(May 1973). (In Japanese).

According to the long-range program of atomic energy development and utilization by the AEC, nuclear power generation in Japan will reach the level of 100 million kW by 1990. Though dependent on the enrichment services of the U. S. for nuclear fuel for some time yet, the supply of enriched uranium is destined to be in shortage. The problem of uranium enrichment is described as follows: perspective, Japan's enriched uranium policy, enriching techniques, demand and supply situation, and recent trends in overseas countries. For the enriched uranium, Japan is scheduled to rely on the capability of the U. S., international joint venture, and domestic production. As for the recent trends abroad, those concerned with Japan's participation in the joint venture are reviewed; namely those in the U. S., France, and joint development of centrifugal separation by three European countries. (JA)

24121 THE SEPARATION OF URANIUM ISOTOPES IN THE PRESENCE OF LIGHT GAS WITH PARTICULAR RESPECT TO THE SEPARATION NOZZLE PROCESS. Fuhse, W. A. Atomkernenergie; 23: No. 3, 212-215(1974).

2 figs.; 7 refs.

Previous theoretical considerations on the separation nozzle process, although in principle showing the trends experimentally obtained, could not explain quantitatively the actual separative performance. The foundation of a comprehensive separation theory is evaluated. It is shown that the pressure diffusion due to the pressure drops along the flow path have to be taken into account to explain the experimental results. Subsequently, a simple formula is evaluated to estimate the maximum separative power of separation nozzles in the same way as the equation of Dirac is used for gas centrifuges. Due to non-optimum boundary conditions the existing separation nozzles can only reach an efficiency of about 61%. (auth)

24122 UNITARY STACKED PRESSURE TOWER. Nazzer, D. B. (to Canadian General Electric Co. Ltd.). Canadian Patent 943,855. 19 Mar 1974.

Heavy water is obtained by isotopic exchange between water and hydrogen sulfide gas in a plant having hot and cold exchange zones provided in a stacked tower structure, with the cold tower portion surmounting the hot water tower portion and having a heat exchange dehumidifier section interposed within the unitary tower. (CA)

Isotopic Power Sources

24123 (COO-2155-12) BIOMEDICAL ENGINEERING SUPPORT. Third Quarterly Report, February 16–May 15, 1974. Smith, L. M.; Sandquist, G. M. (Utah Univ., Salt Lake City (USA)). [nd]. Contract AT(11-1)-2155. 86p. Dep. NTIS $7.50.

During the reporting period a fit trial experiment was conducted to determine and evaluate the accommodation in a calf of the proposed Westinghouse blood pump drive train and electric motor configuration. The proposed system would permit exchange of the electric motor with the plutonium loaded thermal converter sometime after total heart replacement had occurred and the calf was convalescing. Modifications were made and a tentative drive train system was established which would permit successful interchange of the electric motor and thermal converter. Tentative surgical protocol and procedures were developed for future total heart implantation experiments, including the protocol for thermal converter exchange and implantation. The application for a Special Nuclear Materials License (as Amendment Number 6 to the University of Utah's SNM663) has been prepared and submitted to the AEC Division of Material Licensing. It is anticipated that no serious obstacles will arise in acquiring permission from the AEC to receive and utilize the encapsulated Pu-sources. Modifications to the electric motor controller unit were made to provide higher maximum output torques and permit electrical monitoring of certain operating variables. The electric motor housing was modified to accommodate a tubular wound cooling system which could remove heat generated by the electrical motor and maintain local surrounding tissue at acceptable temperatures. An AEC Artificial Heart Program Planning Meeting composed of AEC, WANL, Philips, University of Utah and other personnel, was held at the Institute for Biomedical Engineering at the University of Utah, from April 29 to May 1, 1974. The fit trial experiments were conducted and tentative protocols were established in addition to discussion and planning related to the program's goals. (auth)

24124 (COO-3043-13) NUCLEAR-POWERED ARTIFICIAL HEART PROTOTYPE SYSTEM DEVELOPMENT PROGRAM. Phase III. Quarterly Progress Report, October 1, 1973–December 31, 1973. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1973. Contract AT(11-1)-3043. 81p. Dep. NTIS $7.25.

Thermal insulation component development continued. Outgassing tests were performed and analyzed and outgassing procedures developed. Work on spacer and cup technology development continued. The outgassing evaluation test apparatus was modified and design of the thermal evaluation test apparatus was initiated. Life test data from the 20-cup pack were analyzed and tests were initiated with the 40-cup pack, using the guarded orientation test apparatus. Thermal converter component development efforts continued on five of the components originally chosen for further development: the hot finger, the stationary regenerator, the control system, the bellows seals, and the oil pump. Blood pump component development efforts continued. Analyses of planetary gear tests and the liquid filled drive test from the previous reporting period were completed. Similar tests using the Evoloid gear reducer were performed and are being analyzed. Initial results from the soaking of silicone rubber in oil were obtained; these tests are continuing. Auxiliary component development had emphasis during the quarter on the waste heat coolant loop and coolant pump. For the intermediate system, this function is expected to be performed by a flexible water heat pipe. Because of the shorter time available for development of components for the IVBM, it was decided to use a pumped loop system for the IVBM. The prime circulating pump candidate for the IVBM is a bellows type pump located inside the blood pump mechanism. Design of the thermal insulation for the electrically heated IVBM was initiated. A vendor for the nickel foil cups was selected. The conceptual and the preliminary designs of the IVBM thermal converter were completed. Detailing was initiated on the hot finger/displacer/heat exchanger assembly, as well as on the drive, enclosure, and several of the accessories. The detailing of the first item was completed. The other three times are still in the detailing stage. Design work on the IVBM blood pump drive mechanism was initiated. The design status of the mechanism per se is discussed along with design considerations for the bellows coolant pump that is planned for the IVBM. The conceptual design of the intermediate system was completed and a topical report was prepared describing this design along with the factors that led to selection of design features. System integration on the IVBM was initiated and a status review is presented. Reliability activities centered about design reviews for the IVBM and the intermediate system, upgrading the failure mode effects analysis for the intermediate system, component testing and component failure analysis. The Phase II bench model Thermal Converter No. 2 was placed on life test on October 22. The converter operated initially without incident. During early November, several of the life test support equipment components failed. During these equipment failures, the thermal converter continued to operate satisfactorily. On November 21, the converter ceased operation with 729 h cumulative time at power. Test instrumentation indicated the failure was caused by a loss of engine compression. Later teardown inspection of the thermal converter revealed a perforation in the inner roll sock, confirming the test instrument assessment. Support was provided for another in-vivo blood pump experiment at the University of Utah. The blood pump was implanted in a calf and driven by an external electric motor through a 36 in. long flexible drive shaft. The experiment was terminated 25 h after implantation when the flexible shaft core broke. The core failure occurred near the end of the casing fitting connected to the blood pump. No permanent deformation of the casing near the core failure was observed. A failure analysis is being performed to determine the cause of the core failure. (auth)

24125 (COO-3043-15) NUCLEAR-POWERED ARTIFICIAL HEART PROTOTYPE SYSTEM DEVELOPMENT PROGRAM. Phase III. Quarterly Progress Report, January 1, 1974–March 31, 1974. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1974. Contract AT(11-1)-3043. 77p. Dep. NTIS $7.00.

Thermal insulation component development continued. The thermal evaluation of the 40 nickel cup pack in the vertical orientation was completed. Five nickel cups with plasma sprayed zirconia were received, and thermal evaluation was initiated. Additional calibration testing on the guarded heater systems was completed, and these results were analyzed. The outgassing evaluation continued and calibration of the mass spectrometer system is being completed. Thermal converter component development efforts continued on four of the components originally chosen for further development: the hot finger, the control system, the bellows seals, and the oil pump. In addition, efforts were initiated on the development of shaft seals. Blood pump component development efforts continued. Development efforts were pursued on the flexible shaft including analysis of calf implantation experiments at Utah. The final results of the speed reducer and liquid filled drive tests were analyzed. A pump housing deflection test was conducted and bearing and lubricant investigations continued. A materials evaluation for the IVBM drive mechanism component was completed. Auxiliary components development continued with emphasis on the waste heat coolant loop and coolant pump. Design analyses were completed for the coolant loop being developed in preparation for the IVBM. Design of the IVBM thermal insulation packages continued. Drawings were issued for machining mandrels and electroplating nickel cups on the mandrels. Layout drawings were prepared for the 60 cup package and the outer vacuum container. The design of the IVBM thermal converter is nearing completion. Items remaining to be done include: the detailing of the nuclear hot finger, the final lay-out of the oil distribution circuit, and the detailing of the new throttling valve for the control system. Design of the IVBM blood pump drive mechanism continued. Layout drawings of many of the components were completed. The bellows coolant pump configuration was modified and materials were selected for the blood pump drive mechanism components. An engineering evaluation of two stage implantation was initiated. As part of this evaluation, a tentative implantation protocol was prepared for both stages. A design review of the IVBM was held on the thermal converter and blood pump configurations. The results of the design review have been documented and action items are in the process of being closed out. Failure analysis of the flexible shaft was conducted. Fabrication activities for the IVBM thermal insulation packages were initiated. Significant progress was made on fabrication of the thermal converter components. Two mock circulation units were completed and checked out. (auth)

24126 (COO-3043-16) NUCLEAR-POWERED ARTIFICIAL HEART PROTOTYPE SYSTEM DEVELOPMENT PROGRAM. Phase III. Quarterly Progress Report, April 1, 1974–June 30, 1974. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1974. Contract AT(11-1)-3043. 165p. Dep. NTIS $11.25.

Thermal insulation component development continued during the reporting period. The 26 skirted cup test insulation package was assembled and tested. The guarded heater insulation test stands were evaluated using the 40 cup pack and the 5 cup ZrO_2 plasma-sprayed cup pack. Thermal converter development was continued on five specific components; hot finger, control valve, oil pump, bellows seals, and shaft seals. Blood pump drive mechanism component development progress is discussed. An investigation of the possible causes of failure of the flexible shaft in the February in-vivo implantation at the University of Utah was continued without isolating the failure mechanism. New, higher strength, flexible shafts were procured and tested and a test rig permitting pulsatile loading of shafts without use of a blood pump and circulation loop was assembled. Ball bearing and lubricant investigation was continued. Work continued on the detail design of the test rig for the IVBM coolant loop. Preliminary testing of commercial heat pipes was completed and specifications were prepared for heat pipes satisfying the special requirements of the Intermediate System. All design tasks for the electrical IVBM insulation package were completed. The design of the IVBM thermal converter was completed and is described. The weight exceeds the design goal by approximately 800 g because the IVBM schedule did not permit time to evaluate and incorporate possible lighter weight material substitutions. The blood pump drive mechanism design was completed and most of the components were released for manufacture or purchase. The previously developed two-stage implantation approach was subjected to a trial fit in a calf cadaver using wooden models. The configuration was determined to be unnecessarily complex and design iterations, described in this report, have resulted in simplification of both the components and the implantation procedures. Progress in the fabrication of the insulation cups and fluff foil is reported. The 60 cup electrical IVBM insulator package was manufactured, assembled, and placed on test. The thermal converter fabrication was significantly advanced. Detail parts and subassemblies for the fabrication of two engines are in process. Photographs of parts in process or completed as of mid-June are included. Procurement action was initiated for the blood pump drive mechanism fabrication effort and for the auxiliary components. (auth)

24127 (MLM-1387) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: OCTOBER–DECEMBER 1966. (Mound Lab., Miamisburg, Ohio (USA)). 28 Mar 1967. Contract AT-33-1-Gen-53. 86p. Dep. NTIS $7.50.

Declassified 30 Aug 1973.

Research progress is reported on the preparation, properties, and performance of ^{238}Pu and ^{210}Po isotopic heat source fuels. (TFD)

24128 (MLM-1387(Suppl.)) PLUTONIUM-238 AND POLONIUM-210 DATA SHEETS. Supplement to Mound Laboratory Isotopic Power Fuels Programs: October-December 1966. (Mound Lab., Miamisburg, Ohio (USA)). 1 Mar 1967. Contract AT-33-1-Gen-53. 71p. Dep. NTIS $6.75.

Declassified 30 Aug 1973.

Technical data available for the isotopic heat source fuels, ^{238}Pu and ^{210}Po are presented. The data includes those properties of the materials that affect their performance as heat sources in isotopic power supplies, e.g., composition, specific power, power density, thermophysical properties, mechanical properties, chemical properties, biological tolerances, shielding data, and compatibility with container materials. Data are included for ^{238}Pu, $^{238}PuO_2$, ^{238}PuN, ^{238}PuC, ^{238}Pu-Zr alloy, ^{210}Po, $^{210}PoGd$, and $^{210}PoGd$ in a Ta matrix. (TFD)

24129 (MLM-1406) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: JANUARY-MARCH 1967. (Mound Lab., Miamisburg, Ohio (USA)). 5 May 1967. Contract AT-33-1-Gen-53. 58p. Dep. NTIS $6.00.

Declassified 30 Aug 1973.

Research progress is reported on the preparation, properties, and performance of ^{238}Pu and ^{210}Po isotopic heat source fuels. (TFD)

Radiation Sources

24130 (ORO-3936-6) VAPOR EXPLOSION: HEAT TRANSFER AND FRAGMENTATION. IV. Rapid Quenching of Molten Metal. Witte, L. C.; Cox, J. E.; Gelabert, A. A.; Vyas, T. J. (Houston Univ., Tex. (USA). Dept. of Mechanical Engineering). Aug 1971. Contract AT(40-1)-3936. 45p. Dep. NTIS $5.25.

An experimental investigation of rapid quenching of molten metals is described. The studies were oriented toward gaining insight into the mechanisms involved in the fragmentation of molten material. Low melting point metals (mercury, lead, zinc, bismuth, tin, and aluminum) were quenched into water and liquid nitrogen. High-speed photographic sequences of the phenomenon gave considerable insight into the fragmentation phenomenon. Previously proposed theories of fragmentation (violent boiling, shell theory, and the Weber number effect) were examined in light of the results of these experiments and were generally found to be inadequate. The results of this study indicate strongly that: (1) fragmentation occurs when a sample is molten, and (2) fragmentation is a response to an external stimulus. Alternate causes of fragmentation are proposed and predicated upon fragmentation being triggered by the initial collapse of a vapor film around a molten sample. The data also showed that energies required to form new area and to displace water during the fragmentation phenomenon are not significant when compared to the energy available in a molten sample. (auth)

24131 SAFETY TESTING OF RADIATION SOURCES. II. A Study on the Tolerance for Radiation Sources. Ohno, A. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama, Japan); Takishima, N.; Nojiri, T.; Yamamoto, C.; Maebashi, Y. Radioisotopes (Tokyo); 23: No. 5, 312-319(May 1974). (In Japanese).

To determine the safety of sealed radiation sources, various kinds of tolerance tests were carried out that gave an index of tolerance of each source to various physical and chemical conditions. In this experiment, dammy, semihot, and tritium sources were employed. Tolerance tests included tolerance to drugs and tolerance to atmosphere. In the tests of tritium sources, temperature test, pressure test, temperature and pressure test, and soak test were added to these tests. (JA)

Industrial Uses

Refer also to abstracts 24207, 24209, 24233, and 25506.

24132 (AED-CONF-73-461-1) DETERMINATION OF THE MIGRATION RATE FROM PLASTICS ONTO NUTRITIONAL FATS BY MEANS OF A ^{14}C-LABELLED FAT SIMULATING AGENT. Figge, K.; Koch, J. (Unilever Forschungs-G.m.b.H., Hamburg (F. R. Germany)). 1973. 12p. (In German). INIS.

From lecture meeting 1973 of the Deutsche Gesellschaft fuer Fettwissenschaft; Berlin, Federal Republic of Germany (1 Oct 1973).

Methods for judging how safe new packing materials are can be of great importance. Thus a suitable radiotracer method was developed using a ^{14}C-labelled standard triglyceride mixture (fat simulant HB 307 - ^{14}C). The packing material sample is weighed before and after storage in fat simulant HB 307-^{14}C and the content of the test fat in the stored sample is radioanalytically determined. The global migration is equal to the difference in weight of the sample before and after storing in test fat, provided that the amount of fat taken up by the test material is subtracted first from the weight of the stored sample. This method was tested on soft PVC, high-pressure polyethylene, polystyrene and poly(vinylidene chloride) and the dependence of the average error of the individual determination of the global migration amount is discussed. (INIS)

24133 (AED-CONF-73-586-001) THE CONTINUOUS TRACING OF THE WEAR BEHAVIOR OF TRANSMISSION LUBRICANTS IN THE FZG GEAR WHEEL-BRACING TESTING MACHINE BY MEANS OF RADIONUCLIDE TECHNIQUES. Ruedinger, V. Oct 1973. 11p. (In German). INIS.

From joint meeting of the "Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V." together with the "Verein fuer Tiefbohrtechnik e.V." and the "Arbeitskreis Chromatographie" of the "Fachgruppe Analytische Chemie" in the "Gesellschaft Deutscher Chemiker"; Braunschweig, F. R. Germany (3 Oct 1974).

7 figs.; 1 tab.; 14 refs. With abstract.

Deuteron irradiation of the gear flank of the pinion produces a 100 μm thick radioactive material layer. The abrasion particles which arrive at the oil are continuously determined by a flow method. Wear quantities of a few μg can be detected so that gear oils can be essentially much better differentiated with regard to their wear behavior than hitherto. As the material abrasion is directly determined a number of interfering effects can be excluded. By intended activation of single zones it was possible to measure the wear rate varying with the height of the gear flank. A large number of testing runs is possible for the measurement of the wear behavior using a tuned-up gear wheel pair. This is of great significance for the quick development of optimum oil compositions. (auth)

24134 (BARC/I-231) DESIGN AND FABRICATION OF A RADIOMETRIC SORTER. Nair, J. S.; Degaleesan, S. N.; Majumdar, K. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 11p. INIS.

A Radiometric Sorter has been designed and fabricated with indigenous materials for the preconcentration of uranium ores. It consists of an endless conveyor belt on which sized pebbles of uranium ore are fed one after the other from a conical single line feeder. The pebbles pass over a scintillation counter located below the conveyor belt in a lead shielded cabin. The scintillation counter produces a signal proportional to the uranium content of the pebble. If the radiation signal is above a preset value, then the electronic circuit actuates a pneumatic kicker which pushes the pebble off the belt into a concentrate bin; those pebbles whose uranium content is below the preset level, continue to travel on the belt and are discharged into the waste bin. The equipment has been able to discriminate pebbles containing as low as 0.009% U_3O_8 for size (-3-+2½") and 0.02% U_3O_8 for size (-1½-+1") from an ore containing 0.048% U_3O_8. (auth)

24135 (BFL-1/1974) LONG-TERM FEEDING STUDY FOR TESTING THE WHOLESOMENESS OF AN IRRADIATED DIET WITH A HIGH CONTENT OF FREE RADICALS. P. 2. Renner, H. W. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (F. R. Germany)). 1974. 21p. (In German). INIS.

3 figs.; 7 tabs. With abstract in German and English.

In an earlier report a multigeneration feeding study was described, in which rats were fed a diet containing 65% Altromin and 35% milk powder, either unirradiated or irradiated with a dose of 4.5 Mrad. The continuation of this study up to the F_3 generation is reported. From the F_3 generation on, half of the animals in both experimental groups were given drinking water supplemented by a multivitamin preparation. Neither increase in body weights up to 1 year, nor organ weights, nor reproductive performance showed the irradiated diet to have any detrimental effect. In males fed the irradiated diet, the vitamin supplement led to a significant increase in the average body weights after one year of feeding. (auth)

24136 (JAERI-M-5485) DOSE RATE DISTRIBUTION IN THE CENTRAL-SOURCE TYPE WET-WALL REACTOR OF RADIATION ETHYLENE POLYMERIZATION PILOT PLANT-PICW. Nakajima, H.; Yagi, T.; Maruyama, S.; Kodama, A.; Tohei, M. (Japan Atomic Energy Research Inst., Tokyo). Dec 1973. 21p. (In Japanese). NTIS (US Sales Only).

The dose rate and its distribution were measured in the 50-liter, central-source type wet-wall reactor of radiation ethylene polymerization pilot plant-PICW in the presence of air, water and an aqueous solution of tert-butyl alcohol, and the values were compared with those by calculation. The polymerization reactor, 300 mm in diameter and 700 mm high, has an inner

cylindrical casing of outside diameter 96 mm in which a cylindrical source is inserted. Three different ^{60}Co gamma-sources, 3,840, 7,680 and 11,760 Ci, respectively, were used as the sources. The dose rate decreases exponentially in radial directions; the value at the outer surface is $\frac{1}{2}$ that at the inner surface of the reactor. The dose rate along the axis is highest in the middle, and decreases toward the ends. The closer to the source the flatter then becomes the distribution. The mean absorbed dose rates in the presence of tert-butyl alcohol aqueous solution are 0.5×10^5, 1.1×10^5, and 1.9×10^5 rad/hr respectively for the three sources mentioned. With the existence of a scraper, the rate is reduced by 10 %. The utilization efficiency of radiation energy is ~3 %. The calculated dose rate is a little larger than that measured, but the dose rate distribution calculated is similar to that measured. (auth)

24137 THE FIRST TECHNOLOGICAL EXPERIENCES WITH THE ON BOARD-IRRADIATION EQUIPMENT ON THE FFS "WALTHER HERWIG". Feldt, W. (Bundesforschungsanstalt fuer Fischerei, Hamburg (F. R. Germany). Isotopenlaboratorium). Arch. Fischereiwiss.; 24: No. 1-3, 87-93(Aug 1973). (In German).

7 figs.; 3 refs.

During the 44th and 45th voyage of FRV "Walther Herwig" (now "Anton Dohrn") in June-July 1972, equipment for the irradiation of fresh red fish was used for the first time on board. This equipment, except for small defects which could be remedied, proved to be very robust and seaworthy. It was modified in use with small X-ray tube power (30 mA, 200 kV). Therefore, this produced a much too wide distribution of dose in the group of fish irradiated. The maxi/mini relationship was two. In the meantime, the equipment has been modified to full capacity (150 mA, 200 kV) in order to be able to test the question of dose distribution during one of the future voyages. (GE)

24138 ENERGY PRODUCTION BY NUCLEAR FISSION AND SPECIAL POSSIBILITIES FOR THE UTILIZATION OF ACTINIDES. Specht, S. (Technische Univ. Muenchen, Garching (F. R. Germany). Inst. fuer Radiochemie). Chem. Ztg.; 98: No. 2, 87-100(Feb 1974). (In German).

11 figs.; 10 tabs.; 131 refs.

The actinides have found their most important economical application as a source for energy production. The developed systems cover a range of 13 orders of magnitude 10^{-4} W(e) to 1 GW(e). In nuclear reactors the energy is produced by nuclear fission process. The heat, liberated in fission, can be used for electric power generation or as process heat. Radionuclide heat sources (^{238}Pu) have been used in aerospace (heating of scientific equipment and rocket propulsions) and maritime technique (heating of diving suits). Radionuclide batteries (^{238}Pu, ^{242}Cm, eventually ^{232}U) serve as maintenance free power supply over a time of 5 to 10 y of equipment and spacecrafts in aerospace as well as of heart pacemakers (eventually artificial hearts in future) in medicine. Different nuclides of actinides serve as radiation sources for many special measuring techniques and investigation methods. The most important applications are continuous density and thickness gauges, level of filling measurements, and the X-ray fluorescence analysis excited by radionuclides (most important nuclides used: ^{241}Am, ^{238}Pu). Increasing attention is paid to the portable neutron sources (especially ^{252}Cf, $^{238}Pu/Be$) for neutron activation analysis, industrial process control, ore prospection, moisture measuring, neutron radiography, and probably therapy of cancerous tumors. (auth)

24139 RADIOCHEMICAL INVESTIGATION OF FOODSTUFFS AND THEIR CONSTITUENTS. Delincee, H. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (F. R. Germany). Inst. fuer Strahlentechnologie). Chem. Ztg.; 97: No. 8, 438-443(1973). (In German).

52 refs.

Food preservation by ionizing radiation presents for some foodstuffs and certain applications an advantage compared with conventional methods. The chemical changes in the components of irradiated food--proteins, carbohydrates, fats, vitamins, etc.--are discussed. The importance of knowledge of radiation-induced chemical changes for the radiation technology, the identification and the whole-someness of irradiated food is demonstrated. (auth)

24140 PREVENTATION OF DETERIORATION OF POTATOES UPON STORAGE. Background Notes. Food Irradiat. Inform.; No. 2, 52-50(Sep 1973).

3 refs.

Although sprouting is the most obvious manifestation of deterioration during storage, other changes such as rot development, shrinkage, softening, discoloration of the flesh and greening may occur, reducing their quality and affecting their wholesomeness. A number of chemicals can be used as sprout inhibitors and appear to be satisfactory, providing that good storage practices are used. Irradiation, also, is a highly effective treatment for the control of sprouting. The results of 16 years' research in 23 countries concerning the radiation-induced sprout inhibition have been recently compiled. The advantages of this method but also the possible radiation injuries are reported. Wholesomeness studies have revealed no evidence suggesting that irradiated potatoes are harmful. Therefore, a number of countries have authorized the use of radiation for the purpose of sprout inhibition of potatoes. The steps taken towards commercialization are reported. A plant in Japan is expected to commence commercial operation in October or November 1973. (GE)

24141 COMMERCIALIZATION OF POTATO IRRADIATION IN FRANCE. On the Official Approval in France. Pomarola, M. (Laboratoire Central de Recherches et d'Analyses, 91 - Massy (France). Service de la Repression des Fraudes et du Controle de la Qualite); Sandret, F. (Ecole Nationale Superieure des Industries Agricoles Alimentaires, 91 - Massy (France). Centre d'Etude, de Recherche et de Documentation Internationales des Industries Agricoles et Alimentaires). Food Irradiat. Inform.; No. 2, 35-42(Sep 1973). (In French).

13 refs.

In November 1972 it was officially announced that commerce in irradiated potatoes had been authorized in France for a period of five years. The article outlines the steps leading up to this announcement and reviews the detailed provisions of the authorization. No immediate widespread commercial potato irradiation in France is foreseen because further development of the process is required in order to gain data on the economics of the process and consumer acceptance. However, it is anticipated that the clearance will permit research and development to progress with three objectives: (1) to familiarize consumers and eventual users of the process concerning the concept of "treated by ionizing radiation", (2) to define more closely the best uses of the process (e.g., for tubers used by industry at the end of a season, for potatoes intended for consumption in areas with a hot climate, etc.) and (3) to perfect the engineering techniques involved. Potato irradiation is now receiving much attention within the member states of the EEC and this organization, through the Eurisotop bureau, which is coordinating actitivties aimed at eventual commercialization of the process. These activities are briefly reviewed. (GE)

24142 THE POTENTIALS OF IONIZING RADIATION FOR FOOD PRESERVATION. Goresline, H. E. Food Irradiat. Inform.; No. 2, 20-34(Sep 1973).

9 refs.

A review is given outlining the potentials for radiopreservation of foods as they appear presently. Radiation treatment involves the application of energy in the form of gamma rays, x rays or accelerated electrons. (GE)

24143 ESR STUDY ON FREE RADICALS TRAPPED IN IRRADIATED FOODS. I. Rice and Wheat. Namiki, M.; Hayashi, T.; Kameda, K.; Kawakishi, S. (Nagoya Univ., Japan). Nippon Suisan Gakkaishi; 20: No. 10, 478-484(Oct 1973). (In Japanese).

Radical concentrations in rice and wheat grains and their components after irradiation with ^{60}Co γ rays were determined by using ESR spectrometry. These samples were irradiated in N_2 and in air at different moisture contents and then stored at different temperatures. Trapped radical concentration increased linearly with increasing dose up to about 0.5 Mrad and was known to be greatly influenced by moisture content, oxygen and stored temperature, though no marked difference between rice and wheat and among their varieties or classes. A main part of the free radicals observed in the grains of low water content was 23 G in peak width and disappeared fairly quickly in air. On the other hand, the radicals observed in bran (11 G) and gluten (12 G) were considerably stable both in air and in N_2. Consequently, it was demonstrated that no appreciable amount of free radicals remained in rice and wheat grains irradiated with the dose levels necessary for the insect killing and stored at room temperature in air for several days, and accordingly the ESR measurement of residual free radicals would not be available as a tool to detect the irradiated grains. (auth)

24144 COMPARISON OF ON-SITE EFFICIENCY TESTS ON A REVERSIBLE PUMP-TURBINE USING RADIOISOTOPES CONSTANT-RATE-INJECTION AND CURRENT-METER METHODS OF FLOW MEASUREMENT. Evans, G. V. (Atomic Energy Research Establishment, Harwell, Eng.); Aspuru, J. J.; Iberduero, S. A.; Bassy, A. Houille Blanche; No. 7, 593-604(1973).

The radioisotope constant-rate-injection method of flow measurement has been used to measure water flow rates during the on-site testing of a Francis-type reversible pump-turbine at

Santiago del Jares in Spain. Objectively assessed errors of flow rate measurement were between 0.30 to 0.53% (95% confidence level). The measurement of flow rate was compared with measurements derived from pressure differences and guide vane openings calibrated during previous tests in which the flow rates were measured by the use of propeller current-meters. Agreement betwen these measurements of better than ±0.5% was obtained. Values of efficiency derived from the two series of sites tests differed by only 0.44% for the turbine and 0.66% for the pump. These tests have further demonstrated the suitability of the radioisotope constant-rate-injection method for the on-site testing of hydraulic machines. (FR)

24145 PRESENT STATE AND PROSPECTS OF AUTHORIZED RADIATION PROCESSING OF FOOD IN HUNGARY. Farkas, J. (Kozponti Elelmiszeripari Kutato Intezet, Budapest). Izotoptechnika; 17: No. 7, 321-346(Jul 1974). (In Hungarian).

Hungarian research on radiopreservation of potatoes, onions, and mushrooms is discussed. Legal and economic aspects of radiation processing of these foods are also discussed. (auth)

24146 SOME FUNDAMENTAL ASPECTS OF ELECTRON BEAM POLYMERIZATION AND GEL FORMATION. Allen, C. C. Jr. Raleigh, NC; North Carolina State Univ. (1973). 165p. University Microfilms Order No. 74-18,973.

Thesis (Ph. D.).

Methyl methacrylate was polymerized by ionizing radiation from a cobalt-60 gamma-ray source, and with an electron accelerator at dose rates up to three megarads per second. Extrapolation of previous work with methyl methacrylate at low dose rates coincided with our data, apparently obviating the postulated reduction in polymerization rates at high dose rates based upon Chapiro's detailed kinetic scheme. A combination of high polymer with much higher molecular weight than expected was formed, together with a substantial portion of low molecular weight polymer. These results strongly suggest that the polymerization of methyl methacrylate at high dose rates is not as straightforward as first expected, and may involve polymer monomer interaction effects on the termination mechanism, and special initiation effects. Incorporation of small amounts of difunctional cross-linking agents in the methyl methacrylate monomer did not significantly affect the reaction kinetics at relatively low conversions to polymer. As the polymerization proceeded, however, high molecular weight species were formed through cross-linking reactions. These high molecular weight molecules produced an autoacceleration in the rates of polymerization. Solubility characteristics of the copolymer were investigated. Various dimethacrylates, which were used as cross-linking agents had different effects on the kinetic responses of the systems studied. Mathematical models were proposed to correlate our data with previous work. The Flory equation was modified to account for cross-linking reactivities and functionalities. Predictive techniques for the onset of the "gel effect" and the kinetics of the reaction at relatively high conversions were proposed, including the effect of cross-linking agents. The efficiency of polymerization initiation was found to be proportional to the dose rate to the minus one-fourth power over a broad range of dose rates for methyl methacrylate. (Diss. Abstr. Int., B)

24147 PILOT PLANT STUDIES OF RADIATION-INDUCED POLYMERIZATION OF ACRYLONITRILE, ISOBUTYLENE, AND ISOBUTYL VINYL ETHER. Gurak, N. R. Raleigh, NC; North Carolina State Univ. (1974). 120p. University Microfilms Order No. 74-19,019.

Thesis (Ph. D.).

A radiation flow reactor is a novel device in polymerization processes. The expected availability of large amounts of high energy sources makes the use of this type of reactor, potentially, very attractive. In this method of achieving polymerization, the monomer system is exposed to radiation that induces chemical reactions in the medium by serving as a non-contaminating initiator. The reaction may be carried out at any temperature as dictated by the type of monomer and reaction with the use of an efficient temperature control system. To provide an understanding of the principles of design, operation and control of continuous polymerization systems, the polymerizations of three industrially important monomer systems, namely, acrylonitrile, isobutylene and iso-butyl vinyl ether were carried out in a recirculating flow reactor system. (TFD)

LIFE SCIENCES

24148 (LA-5633-PR) ANNUAL REPORT OF THE BIOMEDICAL AND ENVIRONMENTAL RESEARCH PROGRAM OF THE LASL HEALTH DIVISION, JANUARY–DECEMBER 1973. Richmond, C. R.; Sullivan, E. M. (Comps.). (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 165p. Dep. NTIS $7.60.

Research and development activities of the Los Alamos Scientific Laboratory's Biomedical and Environmental Research Program for calendar year 1973 are summarized. We have included information on organization of the participating groups within the Health Division, research interests of the staff, and supporting facilities available at the Los Alamos Scientific Laboratory. Separate abstracts were prepared for each of the 6 sections. (auth)

For abstracts of individual sections see: 23981, 24176, 24177, 24178, 24298, and 24382.

24149 INFLUENCE OF Mn IONS ON THE RADIOMIMETIC ACTIVITY OF SOME ALKYLATING MUTAGENS. Kaul, B. L.; Kak, S. N. (Regional Research Lab, Jammu-Tawi, India). Nucleus (Calcutta); 15: No. 2, 96-101(Aug 1972).

Experiments were performed to observe the effects of divalent Mn on the radiomimetic activity of some alkylating agents using dormant seeds of wheat (Triticum aestivum) as test material. Manganese ions themselves can produce chromosome aberrations but no seed and seedling lethality if given in concentrations above 3×10^{-3} M for about 20 h. The presence of Mn ions with propanesultone (a bifunctional agent), increases seed and seedling lethality and also the number of abnormal cells as well as frequency of chromosomal aberrations. In the case of monofunctional alkylating agents like ethylmethane sulfonate and ethylenimin presence of Mn^{2+} ions gave strong protection against seed and seedling lethality, but enhanced the percentage of abnormal cells and also the frequency of chromosomal aberrations. The data are discussed with special reference to the probable mode of action of manganese ions. (auth)

24150 BIBLIOGRAFICHESKII UKAZATEL' RABOT RADIATSIONNAYA I KHIMICHESKAYA BIOLOGIYA. (1957–1972). (Bibliographic Index of the Institute of the Southern Sea on Problems of Radiation and Chemical Biology. (1957–1972)). Shatilov, A. A. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1974) 58p.

A bibliographic index of articles, books, brochures, and dissertations concerned with radiation and chemical biology is presented. A special section is devoted to foreign articles of special interest. An author index, subject index, and chronological index are also included. 382 references. (JSR)

Radiation Effects on Biochemicals

Refer also to abstracts 23656, 24172, 24176, 24180, 24182, 24215, 24238, and 24293.

24151 (COO-1155-53) PHYSICAL MECHANISMS IN THE INACTIVATION OF PROTEINS BY RADIATION. Final Report. Kuntz, E. (Michigan State Univ., East Lansing (USA). Dept. of Biophysics). 1974. Contract AT(11-1)-1155. 65p. Dep. NTIS $6.25.

Progress is reported on studies of the events from absorption of radiant energy to chemical change or through other modes of dissipation of the energy in proteins and nucleic acids. UV light absorbed by tryosyls in ribonuclease caused an average of 76% greater splitting of adjacent disulfide bonds and an average 85% destruction of that ½ cystine. Other changes occurred, producing 10 species of ribonuclease differing in enzyme activity, isoelectric point, disulfide lability and thermal denaturation. The most efficient energy levels of slow electrons were 200 to 500 eV for inactivation of ribonuclease and tryspin, and 1 MeV electrons or UV or visible light in the presence of photosensitizers induced crosslinking in ribonuclease and in collagen or attachment of free amino acids to the proteins. Radiative re-emission accounts for much of the absorbed energy. At 77°K amino acids and most peptides exhibit total quantum yields for fluorescence plus phosphorescence of one in saline or glucose containing ices. An exception is peptides with a cystinyl adjacent to an aromatic group. Interaction causes complete quenching of phosphorescence and strong quenching of fluorescence. The P/F ratios of amino acids, proteins and nucleic acids are very sensitive to the microenvironment. (auth)

24152 (GSF-BC-50) ELECTRON SPIN RESONANCE AND SPECTROPHOTOMETRIC EXPERIMENTS ON THE MOLECULAR MECHANISM OF REACTION OF WR 638 AND WR 2721 WITH CATALASE. Hahn, A.; Lohmann, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Muenchen (F. R. Germany). Inst. fuer Biochemie). Sep 1973. 44p. (In German). INIS.

Thesis. Submitted by A. Hahn to the Technische Univ., Munich.

The radioprotective effect of the cysteamine derivatives WR 2721 and WR 638 on catalase was studied by means of activity measurements and compared with that of cysteamine. WR 2721 has been found to have the greatest protective effect which increased with rising concentration up to a point of saturation. In order to examine whether this protective effect is due to complex formation with catalase and, if so, to determine the site at which introduction into the enzyme takes place, the changes in the absorption spectra of catalase solutions irradiated in the presence of the radioprotective substances were observed and compared with the spectra of unirradiated solutions, the Soret band serving as indicator for the radiation-induced damage. In this case, WR 2721 proved to be superior over WR 638 and cysteamine in this protective capacity. The reduction of the Sorbet band on irradiation was smaller in the presence of the radioprotective substances than in catalase alone. Hence it is concluded that complex formation with the Fe^{3+} ions occurs in the active centers. When measuring the absorption spectra of an aqueous $FeCl_3$ solution after addition of WR-substances, a new band was observed, indicating complex formation. Here again, WR 2721 showed the greatest effect. As cysteamine showed no reaction in the acidified solution, it is assumed that the complex formation and thus the radioprotective action does not proceed via the SH group but rather via a terminal S^- ion which may be produced either by dissociation of the SH group of the cysteamine or by dephosphorilation of the WR-substances. In order to back up this assumption, ESR studies have been made. Since iron produces a very broad signal in aqueous solution, copper has been used in these experiments as it is also a biologically significant metal. A phosphate group showed no effect or the ESR signals of an aqueous $Cu(NO_3)_2$ solution but after addition of the radioprotective substances, a weakening of the copper signal could be observed which was alike for all three agents, supporting the assumption that an RS^- ion is required in the process. The experimental results clearly show that the WR-substances are forming a complex with the metal ions in the enzyme and are thus capable of partly compensating the radiation damage by transfer of an electron. (INIS)

24153 (KURRI-TR-105, pp 1-5) RELATION BETWEEN PRIMARY COURSE AND CHAIN MECHANISM. Hatano, H. (Kyoto Univ.). 1972. (In Japanese).

Radical formation in molecules of a living body was grasped as radiochemical reaction and radiobiological phenomena were analyzed; the radical formation follows the primary course in which living things absorb radiation energy by irradiation, and ionization and excitation of constitutional molecule of a living body occurs. All phenomena to be analyzed were studied in vitro and ^{60}Co was used mainly. Neutron or electron beams were also used. Ultraviolet radiation and visible light were used for comparison. In a study of radicals formed at low temperature, 77°K, experimental evidence of positive hole shifting concerning elimination and conversion of positive or negative ion radial formed in methionine was obtained. With respect to carbon type radicals out of those formed in protein, phenomena were elucidated that damage existing locally at glycine type specified rest even in compound protein such as hemoglobin appeared generally. As for radical reactions in aqueous solution, new reactions of cleavage of C-S bonding in the reaction with methione were found. In the analysis of change in structure and nature of molecules of living bodies and the analysis of biological activity, a comparison of SH enzyme, urease, and catalase on devitalization of enzymes in aqueous solution was made, devitalization of dehydrogenase of glutamic acid and lactic acid was investigated and it was proved that elimination of SH radical corresponded to devitalization of that. (JA)

24154 (KURRI-TR-105, pp 19-21) DIRECT EFFECT OF LOW SPEED ELECTRON BEAM ON HIGH POLYMER OF A LIVING BODY. Saito, M.; Maki, H. (Kyoto Univ.). 1972. (In Japanese).

Devitalization of RNase by irradiation effects of low-energy electrons (5 to 30 eV) was studied. RNase pellicle was made from 0.01 mg/ml aqueous solution of RNase A (bovine pancreas) on the market, and thickness of pellicle was about 60 A on the assumption that its density was 1.0. RNase activity was measured by a modified method of Kalnitsky et al. A V-shaped tungsten filament was used as the electron beam source and the electron beam was devised to irradiate the sample pellicle at a right angle. Vacuum level during irradiation was $1-2 \times 10^{-6}$ Torr. According to dose reliance curve of RNase devitalization (percent loss) to accelerated

voltage of 2–25 eV, percent loss at dose of above 0.01 μa-hr was about 30% and it reached saturation regardless of an incident electron energy. This suggests that about 70% of RNase pellicle cannot be devitalized by electrons of 2–25 eV. (JA)

24155 (KURRI-TR-105, pp 22-25) RADIOCHEMISTRY OF BASE OF NUCLEIC ACID. Namiki, M. (Nagoya Univ., Japan). 1972. (In Japanese).

With respect to various kinds of scavengers, the relation between change of base of nucleic acid by radiation decomposition induced by secondarily formed radical and intensification or protection of biological effects of radiation was studied. Alcohols showed protective effect and intensification effects because alcohol radical reacted with thymine to form addition products. SCN^- was the most effective scavenger of HO· and it showed simple protective effect. In the case of irradiation of thymine in the presence of sodium formate, it showed markedly protective effect in air, but decomposition of thymine increased and a large quantity of dihydrothymine was produced in N_2. In the case of coexistence with N_2O, N_2O_2, and CO_2 in addition to sodium formate, formation of dihydrothymine (DHT) decreased to one-half. In the case of adenine, sodium formate showed a simple protective effect. In the case of thymine, the decomposition of base was protected in air and it was promoted in N_2 as well as that of thymine. It was found out that thymine glycol returned to thymine in the reaction with e^-_{aq}. Accordingly, a possibility exists that the equilibrium reaction of thymine $\underset{e^-_{aq}}{\overset{\cdot OH}{\rightleftharpoons}}$ thymine glycol exists by irradiation to thymine in N_2 and reverse reaction of e^-_{aq} becomes one of causes for oxygen effect. (JA)

24156 (UR-3490-523) ORGANIZATION AND REPAIR OF MAMMALIAN DNA. Lange, O. S. (Rochester Univ., N. Y. (USA). School of Medicine and Dentistry). 1974. Contract AT(30-1)-4282. 9p. (CONF-740808-1). Dep. NTIS $4.00.

From meeting of federation of European biochemical societies; Budapest, Hungary (25 Aug 1974).

The molecular weight of native mammalian DNA was accurately determined with a semiautomated sucrose gradient system. A monodisperse size distribution of one eighth chromatid pieces was found. This size was confirmed by viscoelastometry. Ionizing radiation, proteases (pronase, trypsin), or mercaptoethanol break each of these units into 21 subunits. These subunits are the double-stranded equivalent of Lett's 165S single-stranded subunit. The intersubunit linkages are exceptionally radiosensitive, yielding a uniform population of subunits after low doses (2 krads). Higher doses yield random breakage of the subunits. Postirradiation incubation at 37°C enables the cells to repair both subunit double-strand breaks and linkages. Models for the organization of the DNA in the mammalian chromosome and for radiation lethality in terms of unrepaired double-strand breaks are discussed. (auth)

24157 ULTRAVIOLET-INDUCED REACTIONS OF THYMINE AND URACIL IN THE PRESENCE OF CYSTEINE. Fisher, G. J.; Varghese, A. J.; Johns, H. E. (Univ. of Toronto). Photochem. Photobiol.; 20: No. 2, 109-120(Aug 1974).

Ultraviolet-radiation photolysis of thymine in the presence of cysteine gives rise to four isomeric dimers, dihydrothymine, and at least five cysteine addition products. Similar reactions occur for uracil but the products have not all been characterized in detail. The addition reactions arise from the triplet state of the pyrimidine. The initial step is production of a hydropyrimidine radical, which then reacts with cysteine to give the addition products. The triplet is quenched by cysteine with a rate constant of about $2 \times 10^8\ M^{-1}s^{-1}$ for thymine and 2.9×10^8 for uracil. The total yield of products gives a lower-limit estimate of the triplet yield and hence of the intersystem-crossing efficiency. These studies, combined with earlier determinations of dimer yields, show that 93% of the thymine triplets which interact with another thymine molecule are quenched without forming stable dimers. For uracil, the corresponding figure is 75%. (auth)

24158 PHOTOCHEMICAL INVESTIGATIONS OF PYRIDINE-NUCLEOTIDES AND MODEL SUBSTANCES. Hanschmann, H.; Stutter, E. (Zentralinstitut fuer Mikrobiologie und Experimentalle Therapie, Jena, Ger.). Stud. Biophys.; 41: No. 3, 181-191 (1973). (In German).

A quantitative evaluation of the time-dependent decrease of the concentration of pyridine-nucleotides and model substances during u.v.-irradiation was carried out. The proposed mechanism of the dimer-formation was confirmed. An explanation for the transition from a first-order-mechanism to a zero-order-mechanism for the different substances employed was given. (auth)

24159 EFFECT OF BASE SEQUENCE ON THE ULTRAVIOLET IRRADIATION PRODUCTS OF DOUBLE-STRANDED POLYNUCLEOTIDES CONTAINING BROMOURACIL AND ADENINE. Ehrlich, M.; Riley, M. (State Univ. of New York, Stony Brook). Photochem. Photobiol.; 20: No. 2, 159-165(Aug 1974).

The effects of ultraviolet irradiation of double-stranded synthetic polynucleotides containing BrU and A have been investigated. Homopolymer pairs and alternating copolymers composed of either ribo- or deoxyribonucleotides were prepared and were irradiated with either 313 nm or ~285 nm light. Strand separation and a modest amount of strand breakage followed irradiation of the homopolymer pairs. Changes in the ultraviolet absorption spectra of the polymers during irradiation reflected the sum of hyperchromic increases caused by progressive strand separation and loss of absorbance caused by photoproduct formation. Extensive debromination occurred. An RNase digest of irradiated poly(rA) · poly^{14}C(rBrU), analyzed by column chromatography, showed components similar to those found previously upon irradiation of single-stranded poly(rBrU). Little photoproduct was released by RNase digestion as mononucleotides. The major photoproduct was in the dinucleotide fraction, and may be 5,5′-diuracil. Base sequence had a profound effect on the sensitivity of the polynucleotides. Irradiation of alternating copolymers with doses of light comparable to those that produced major photochemical changes in the homopolymer pairs brought about little if any change in the copolymers of alternating base sequence. (auth)

24160 RADIATION DAMAGE IN ADENINE AND DNA. Effects of Sensitizing and Protecting Agents. van Hemmen, J. J. Amsterdam; Vrije Universiteit (1974). 100p.

Thesis.

Effects of ionizing radiation on adenine in aqueous solutions were investigated. With the pulse radiolysis method, reactions of the adenine radicals were studied. Electron transfer reactions were shown to occur between the electron adduct of adenine and various electron-affinic compounds. Reconstitution reactions occur in the radiolysis of adenine, both in presence and absence of oxygen. Indications were obtained that the "direct action model" of sensitization is not relevant to pure DNA. It was found that the radioprotective agent cysteamine reacts with DNA radicals, resulting in a decrease of the number of single-strand breaks per molecule. No effect of cysteamine on the number of directly formed double-strand breaks could be detected. The amount of lethal nucleotide damage is not affected by cysteamine, added 1.5 msec after DNA irradiation. (NL)

24161 EFFECTS OF GAMMA-RADIATION IN DNA. Blok, J.; Loman, H. (Vrije Universiteit, Amsterdam). Curr. Top. Radiat. Res.; 9: No. 2, 165-245(Dec 1973).

The inactivation of cells, viruses, and biologically active bacteriophage DNA by x or γ radiation is discussed in relation to the chemical alterations in DNA found after irradiation. The indirect action of radiation on DNA can be studied by irradiating solutions of DNA under various conditions. The available data from such experiments are summarized and it is shown that indirect action may not only be mediated by radicals formed in water, viz. OH, H, and e^-_{aq} but also by secondary organic radicals. DNA damage after irradiation in vivo is due both to direct action of fast secondary electrons and to indirect action of radicals. Because the diffusion distance of free radicals is small the term "localized action" is appropriate for these conditions. The available data on localized action, in particular the production of DNA breaks, are summarized and discussed in relation to inactivation and biological repair. The mathematical aspects of the determination of the number of breaks in DNA from sedimentation experiments are summarized in an appendix. (NL)

24162 THE INCORPORATION OF WRONG BASES BY DNA POLYMERASE I FOLLOWING GAMMA-IRRADIATION OF DNA-LIKE TEMPLATES. Saffhill, R. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Biochim. Biophys. Acta–Nucl. Acids Protein Synth.; 349: No. 1, 23-31(Apr 1974).

The synthesis of polydeoxyribose polymers by Escherichia coli DNA polymerase I was investigated with control and γ-irradiated DNA-like polymer templates containing only two bases. Irradiation of a poly(dA) strand leads to the incorporation of dG, whereas irradiation of poly(dC) and poly(dG) strands both lead to the incorporation of dA. Irradiation of poly(dT) does not lead to the incorporation of any wrong base. The wrong bases are incorporated into the complementary strand of the newly synthesized DNA. (NL)

24163 STRUCTURAL DAMAGE IN GAMMA-IRRADIATED LYSOZYME. Marciani, D. J.; Tolbert, B. M. (Colorado Univ., Boulder). Biochim. Biophys. Acta–Protein Struct.; 351: No. 2, 387-395(Jun 1974).

The distributions of the different kinetic classes of exchangeable hydrogens were measured for γ-irradiated lysozyme (mucopeptide N-acetylmuramylhydrolase, EC 3.4.1.17). Class I hydrogen, associated with fully exposed structures, did not show significant alterations as a function of radiation dose. Class II hydrogen, associated with relatively unhindered peptide groups,

showed an increase that is a function of radiation dose. Class III and IV hydrogen presented an almost equal rate of decrease that is exponentially related to the dose. The decrease of Class III and IV hydrogens seems to indicate a disruption of structures such as α-helical and β-structures, and destruction of hydrophobic regions, which maintain the tertiary structure of the protein. Difference-spectra studies corroborate these results, presenting the more damaged fractions a higher degree of tryptophan exposure as compared to native lysozyme. Spectroscopic studies in presence of guanidine hydrochloride revealed new chromophore(s) groups, which seem to originate from tryptophan. The relationship between the damage of hydrophobic groups and structural damage is discussed. (NL)

24164 INTRACELLULAR COMPETITION FOR A MISMATCH RECOGNITION SYSTEM AND MARKER–SPECIFIC RESCUE OF TRANSFORMING DNA FROM INACTIVATION TO ULTRAVIOLET IRRADIATION. Guild, W. R.; Shoemaker, N. B. (Duke Univ., Durham, N. C. (USA). Dept. of Biochemistry). Mol. Gen. Genet.; 128: No. 4, 291-300(Feb 1974).

5 figs.; 2 tabs.; 20 refs.

Donor-recipient heterozygosity for unlinked genes allows low efficiency markers in transforming DNA to escape from attack by the discrimination system present in Diplococcus pneumoniae of genotype hex^+. The observed efficiency of a marker is a function of donor DNA concentration, duration of exposure, and relatedness of the donor to the recipient strain. Efficiency can be increased at least six to seven fold by addition of excess homologous but nonisogenic DNA, which appears to compete for a limited amount of an enzyme system recognizing mismatched heteroduplexes. Low efficiency markers are often hypersensitive to ultraviolet irradiation of the donor DNA, and this effect also is reversed by the presence of excess nonisogenic homologous DNA, leading to a dramatic (for example, 260-fold) marker-specific rescue from inactivation. (auth)

24165 EFFECT OF FAST NEUTRONS ON HUMAN GAMMA GLOBULIN AND SERUM ALBUMIN. Stefanova, M.; Svestarova, M.; Vasileva, V. Folia Med. Sofia); 14: No. 5, 295-304 (1972).

Differential spectra made of human gamma globulin and human serum albumin irradiated with various doses of fast neutrons and model mixtures of aromatic amino acids in relation to native protein were studied. Minimal values shown in differential spectra of irradiated proteins make it possible to assume that shifts in the position of the chromophores begin towards the surface of the globula. The red shift, which is observed at the maximum of the absolute spectra, is probably due to ionization of the phenol group in the tyrosyl residues. The curves of titration used in calculating the number of free phenol groups were also drawn. The additional alkaline denaturation does not lead to further noticeable changes. (Abstr. Bulg. Sci. Med. Lit.)

24166 STUDIES OF THE ROLE OF SUPEROXIDE DISMUTASE AND SUPEROXIDE RADICALS IN HYDROXYLATION REACTIONS AND IN RADIATION LETHALITY. Goscin, S. A. Durham, NC; Duke University (1974). 146p. University Microfilms Order No. 74-13,477.

Thesis (Ph. D.).

p-Cresol and 4-nitrophenol were hydroxylated in reaction mixtures containing dihydroxyfumaric acid, ferrous sulfate, and oxygen. The accumulation of hydroxylated product exhibited an initial lag, whereas the oxidation of dihydroxyfumaric acid did not. This lag was eliminated by H_2O_2. Hydroxylation was partially inhibited by superoxide dismutase, catalase, or formate and was completely inhibited by ethanol. The results suggest that the active hydroxylating species was $OH\cdot$ and that $O_2^{-}\cdot$, although not functioning directly as a hydroxylating agent, did serve to generate $OH\cdot$ by a reaction that involved H_2O_2. Superoxide dismutase was isolated from Saccharomyces cerevisiae, a unicellular eucaryote, and was found to be a blue-green, copper- and zinc-containing enzyme similar to superoxide dismutases already described from a number of multicellular eucaryotes. In radiation biology the term oxygen effect refers to the fact that, in general, a biological system irradiated in the presence of oxygen is more radiosensitive than the same system irradiated in the absence of oxygen. The magnitude of the oxygen effect for a given system is expressed as the oxygen enhancement ratio (OER), the ratio of the radiation dose required to produce a defined effect on the system in the absence of oxygen to the dose required to produce the same effect in the presence of oxygen. The potential role of the superoxide radical in the molecular mechanism of the oxygen effect was investigated by measuring oxygen enhancement ratios for Escherichia coli B cells containing high and low levels of the enzyme superoxide dismutase. The level of superoxide dismutase in the cells was found to have no effect on the oxygen enhancement ratio. This result is not consistent with the proposition that the superoxide radical is involved in the mechanism of the oxygen effect. Addenda to the dissertation present partially complete studies. These studies deal with the role of the superoxide radical in hydroxylations effected by the dihydroxyfumaric acid-horseradish peroxidase-oxygen and purine-xanthine oxidase-oxygen hydroxylating systems, the induction of superoxide dismutase in Saccharomyces cerevisiae, and the investigation in an in vitro system of the potential role of the superoxide radical in the oxygen effect. (Diss. Abstr. Int., B)

24167 CORRELATION BETWEEN INHIBITION OF UREASE ACTIVITY AND STRUCTURAL MODIFICATIONS IN UREASE AFTER ^{60}Co γ IRRADIATION. Robin, J. M.; Raymond, J.; Uliana, R.; Azanza, J. L.; Creac'h, P. V. (Univ., Bordeaux). Compt. Rend. Soc. Biol.; 167: No. 11, 1585-1590(1973). (In French).

The irradiation of urease preparations with increasing doses of γ radiations leads to the progressive disappearance of outer SH. SH, which is not bound to the activity, and then the SH, which is bound to the activity, are successively destroyed. Various physical measurements made on the optical properties of the enzyme solution established the existence of various structural modifications which accompany the reduction in enzymatic activity. The 150 KR dose inducing the sub-total inhibition of this activity constitutes a threshold between two different radiodenaturation processes. There thus exist certain correlations between the inhibition of enzymatic activity and structural modifications. (FR)

24168 CLEAVAGE OF ULTRAVIOLET LIGHT-IRRADIATED DNA BY SINGLE STRAND-SPECIFIC S1 ENDONUCLEASE. Shishido, K.; Ando, T. (Inst. of Physical and Chemical Research, Wako, Japan). Biochem. Biophys. Res. Commun.; 59: No. 4, 1380-1388(19 Aug 1974).

It was evidenced that the single strand-specific S1 endonuclease could cleave the ultraviolet light-irradiated T7 DNA. The cleavage of ultraviolet light-irradiated T7 DNA by S1 endonuclease was studied by sucrose density gradient centrifugation. The extent of cleavage was proportional to the dose of ultraviolet light given, the concentration of endonuclease and the ionic strength in the reaction. The cleavage consisted of both single-strand and double-strand breaks. The double-strand breaks were observed even at relatively lower dose of ultraviolet light. It seems likely that S1 endonuclease can recognize the alteration in the double-helical structure produced by ultraviolet light-irradiation rather than specifically attack ultraviolet light-induced photoproducts. (auth)

24169 ABSENCE OF A PYRIMIDINE DIMER REPAIR MECHANISM IN MAMMALIAN MITOCHONDRIA. Clayton, D. A.; Doda, J. N.; Friedberg, E. C. (Stanford Univ., CA). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 7, 2777-2781(Jul 1974).

We have investigated whether mammalian cells can repair pyrimidine dimers in their mitochondrial DNA which have been induced by ultraviolet light. The assay system is based upon the ability of the phage T4 UV endonuclease to nick covalently closed circular mitochondrial DNA that contain pyrimidine dimers. Our results show that dimers are not removed from the mitochondrial DNA of mouse L cells or human KB and HeLa cells. There is also no evidence for photoreactivation of mitochondrial DNA. Analyses of ethidium bromide-cesium chloride equilibrium density gradients of mitochondrial DNA isotopically labeled before and after exposure to ultraviolet light show that the total amount of DNA replication is depressed after exposure. In addition, an increase in the frequency of molecules banding at a position expected for intermediate replicating forms and open circular daughter molecules suggests that the rate of replication is slower (or arrested) in molecules with pyrimidine dimers. The absence of a significant amount of mixing of label incorporated before and after ultraviolet-irradiation is evidence against the occurrence of a large amount of genetic exchange between mitochondrial DNA molecules under these conditions. (auth)

Radiation Effects on Cells

Refer also to abstracts 24153, 24238, 24241, 24250, 24321, 26192, and 26193.

24170 (AAEC-LIB/Trans-522) CHROMOSOME ABERRATIONS OF HUMAN LYMPHOCYTES AFTER X-IRRADIATION IN VITRO. Schmid, E.; Bauchinger, M.; Hug, O. Translated from Mutat. Res.; 16: 307-317(1972). 30p. INIS.

Human peripheral lymphocytes were irradiated with different doses of 220 kV x rays. The frequency of different aberration types was determined and dose-response curves were constructed. The data were fitted by least squares regression analysis to a power law and linear quadratic model, as well as to the special cases of

a pure linear and a D^2 relation. If in a cell an exchange and several acentrics should be observed, either two fragments (assuming an incomplete exchange) or only one fragment (complete exchange) were assigned to the exchange. This results in two groups of acentric fragments ac_2 and ac_1 respectively. The dicentric, dicentric + centric ring, and different acentric data gave the best fit to the linear quadratic model $Y = c + \alpha D + \beta D^2$. The data for atypical translocation chromosomes are an exception and best fit a D^2 relation. With regard to the aspect of biological dosimetry a systematic investigation and interpretation of dose-effect relationships in human peripheral lymphocytes is given. Possible reasons for discrepancies between results of different laboratories, e.g. the varying statistical and mathematical treatment of experimental data, are discussed. (auth)

24171 (AED-CONF-74-140-007) THE RADIOSENSITIVITY OF HUMAN AND ANIMAL MELANOMAS IN VITRO AND IN VIVO. Trott, K. R.; Kummermehr, J.; Lukacs, S.; Schneider, C. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Biologie). 1974. 3p. (In German). INIS.

From German X-ray congress; Baden-Baden, F. R. Germany (25 Apr 1974).

The decrease of colony forming ability of cells of a human malignant melanoma after various radiation doses was compared to that of HeLa cells. The radiosensitivity of both cell types was within the same range. Melanoma cells, however, showed a greater radiosensitivity at higher doses. The dose-response curve of melanoma cells differed from that of HeLa cells. From this it was concluded that the melanoma cells have a distinct compensation ability and the ability of Elkind repair. The consequences that can be drawn from these results for radiotherapy are elucidated. The dose-response curves of Chinese hamster melanoma cells in vitro and in vivo and of isolated cells of the Harding-Passey melanoma in vitro are investigated. The results could not support the doctrine of the greater radioresistance of melanoma cells. (GE)

24172 (CONF-740715-7) CELLULAR AND SUBCELLULAR BIOLOGY: REVIEW OF THE V INTERNATIONAL CONGRESS OF RADIATION RESEARCH. Elkind, M. M. (Argonne National Lab., Ill. (USA)). 1974. 29p. Dep. NTIS $4.50.

From 5th international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

Research programs on radiobiology are reviewed. Emphasis is placed on studies of mechanisms for the repair of radiation injuries at the cellular and subcellular (DNA) level; radioinduced carcinogenesis; chemical sensitization to radiation; and the shape of the initial portion of the dose effect curve (low-dose irradiation). (CH)

24173 (IAEA-R-873-F) IRRADIATION INDUCED CHANGES IN RED BLOOD CELL METABOLISM AND MEMBRANE STRUCTURE. Final Report, 1 April 1967–31 December 1972. Hollan, S. R. (International Atomic Energy Agency, Vienna (Austria)). Jun 1973. 7p. (IAEA-R-503-F). INIS.

A comprehensive examination was made in mature or immature human erythrocytes, chicken and rabbit erythrocytes for the biochemical alterations in membrane and metabolic disturbance after in-vitro x- or γ-irradiation with 1,000 to 25,000 R. In mature human erythrocyte, permeability increased for monovalent cations, mercuric ions and compounds, glycerol, and thiourea. G-6-P dehydrogenase and hexokinase were activated with the latter leading to the decreased ATP level in the cell. Glutathione reductase showed a decreased activity. Iron exhibited a radiosensitizing effect with regard to membrane permeability for alkali cations and heavy metals. No changes were observed in chicken erythrocyte membranes in permeability and in binding capacity for iron from crystalloid medium. Iron uptake from transferrin–iron complex, however, decreased by 25 to 35% after exposure to 25,000 R x-ray, by which a 30 to 60% decrease in Hb synthesis was also noted. In foetal human erythrocytes uptake of free iron or iron from labile transferrin–iron complex increased by 150 to 200% after γ-irradiation with 25,000 R. Treatment with NaCN (5mM) or fluoroacetate (16mM) inhibited the iron uptake by immature cells from labile transferrin–iron complex, and also abolished the enhanced iron uptake observed after γ-irradiation with 25,000 R or treatment with inosine (10-M) and adenine (1mM). In rabbit erythrocyte irradiation lead to the irreversible injuries in mitochondria and a concommitant disturbance in intracellular iron transport between cell membrane and mitochondria. (INIS)

24174 (JPRS-62082, pp 1-8) CYTOLOGICAL AND CYTOGENETIC EFFECTS IN THE CELLS OF BACTERIA AND MAMMALS UNDER THE INFLUENCE OF ACCELERATED HEAVY IONS. Grigor'ev, Yu. G.; Ryzhov, N. I.; Fedorenko, B. S.; Krasavin, E. A.; Vorozhtsova, S. V.; Koshcheeva, L. A.; Savchenko, N. Ya.; Khlaponina, V. F. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 2, 3-8(1974).

Studies were made of the biological effectiveness of post-radiation recovery processes and factors modifying radiological effects brought about by the action of heavy ions and standard radiations on bacterial E. coli B cells and mammalian cells. Heavy ions exhibited a more pronounced biological effect. Bacterial and mammalian cells exhibited somewhat similar responses to radiations with high linear energy losses (LEL). This is suggested by a similarity in the direction and picture of damage. There were also significant qualitative and quantitative differences related to the species and organization of the biological objects tested. This applies mainly to the different relationships between the relative biological effect changes and LEL. (auth)

24175 (JPRS-62553, pp 20-25) STATE OF THE NEUROSECRETORY NUCLEI OF THE HYPOTHALAMUS AFTER COMBINED EXPOSURE TO ACCELERATION AND IONIZING RADIATION. Andrianova, L. A. 24 Jul 1974. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 14-17(1974).

An analysis of the functional state of hypothalamic neurosecretory nuclei of rabbits after combined exposure to accelerations and γ radiation revealed that the content of the neurosecretory substance in the neurons had changed. These changes were similar to those observed three hours after exposure to ionizing irradiation: a tendency to normalization of the antidiuretic activity of the plasma and accumulation of the secretion in neurons of nuclei in the anterior hypothalamus. (auth)

24176 (LA-5633-PR, pp 42-74) CELLULAR AND MOLECULAR RADIOBIOLOGY. May 1974.

In annual report of the Biomedical and Environmental Research Program.

Results are reported from studies within the framework of radiation effects, on DNA model systems, identification of products of radiolysis, organic synthesis and enzymatic amplification, studies of radiation effects on transcription and translation fidelity and bacterial virus induction. Cycle-dependent, radiation-induced, metabolic effects have been augmented by techniques for mass synchrony and rapid cell-cycle analysis. Clear effects on small RNA metabolism, histone phosphorylation, and deoxynucleotide triphosphate pool kinetics have been shown to occur following exposure to biologically significant radiation doses. These are subtle but significant effects not readily demonstrable by conventional analyses. (CH)

24177 (LA-5633-PR, pp 75-116) BIOPHYSICS AND INSTRUMENTATION. May 1974.

In annual report of the Biomedical and Environmental Research Program.

Research areas include (1) instrumentation for the rapid analysis and sorting of mammalian cells, (2) development of cell staining and preparation techniques suitable for these flow-systems instruments, (3) application of these instruments to clinical and basic biological research, (4) radiation biology, (5) dosimetry related to the pion beam at the LAMPF, and (6) a continuing effort in computer and electronic development in support of the LASL biomedical program. Specific activities in these various areas are discussed. (WHK)

24178 (LA-5633-PR, pp 117-136) ORGANIC AND BIOCHEMICAL SYNTHESIS. May 1974.

In annual report of the Biomedical and Environmental Research Program.

The program continues to produce a variety of labeled materials (following the necessary research and development of organic and biosynthetic methods) required for clinical, biomedical, chemical, and environmental applications which serve as effective demonstrations of unique and advantageous utilization of stable isotopes. The necessity to convert basic starting materials from the enrichment process (carbon monoxide and nitric oxide) into the wide variety of labeled compounds required for the various applications, resulted in a unique synthesis capability, which effectively utilizes and combines the many techniques of organic and biochemical synthesis. Additionally, in accordance with major program objectives (although not reflected in its new title), the group actively initiates and participates in many of the applications of these materials in various research and development projects which include clinical diagnostic trials, biochemical and chemical research, and metabolic studies. (MCG)

24179 THE EFFECT OF IONIZING RADIATION ON AMINO ACID TRANSPORT SYSTEMS IN THYMOCYTES. Kwock, L.; Wallach, D. F. H. (Tufts-New England Medical Center, Boston). Biochim. Biophys. Acta–Biomembranes; 352: No. 1, 135-145 (May 1974).

The radiation effect on K^+ transport was implicated as a cause for the high radiosusceptibility of thymocytes. The effects of

radiation (0.05 to 10 krad) on the Na^+-dependent transport of 2-aminoisobutyric acid and the Na^+-dependent transport of 1-aminocyclopentane-1-carboxylic acid and b-2-aminobicyclo |2.2.1|-heptane-2-carboxylic acid were studied to determine if these transport systems are similarly impaired. It was found that insulin and concanavalin A, which increase 2-aminoisobutyric acid influx by increasing V, protects the thymocyte 2-aminoisobutyric acid system against the effects of radiation. Trypsin, which mimics the effects of insulin in fat cells and hepatocytes, was also found to protect the transport system. The results suggest Na^+-K^+ transport and 2-aminoisobutyric acid transport may be coupled in rat thymocytes and that the coupling factor is radiosensitive. This component affects either the rate of substrate turnover, by possible rearrangements of plasma membrane components, or the number of carrier sites. (NL)

24180 EFFECTS OF IONIZING RADIATION ON RNA METABOLISM IN CULTURED MAMMALIAN CELLS. Enger, M. D.; Walters, R. A.; Campbell, E. W. (Los Alamos Scientific Lab., NM). Biochim. Biophys. Acta–Enzymol.; 353: No. 2, 227-237 (Jun 1974).

During the latter portion of the division delay period, which follows exposure of cultured Chinese hamster cells to 800 rads ionizing radiation, there is an increased incorporation of ^3H-uridine (relative to control cells) into heterogeneous nuclear RNA (HnRNA) and polysomal mRNA without a corresponding increase of incorporation into informosomal messenger-like RNA. The nature of this effect was further investigated. The increased net incorporation reflects an increase in incorporation rate, not a decrease in breakdown; 5-, 10-, and 20-min pulses result in the same relative incorporation into HnRNA of irradiated and control cells. The rate of mRNA decay in actinomycin-treated irradiated and control population is comparable. The magnitude of the effect is the same after 800 and 1600 rads. The effect is not apparent when synchronized cells are irradiated in G_1 and the incorporation rates in late interphase of control and irradiated populations are measured. The effect of irradiation on relative rates of uridine incorporation into messenger-related RNAs is concluded to be a reflection of (1) the fact that the irradiated population is arrested in G_2 (period between end of S (the DNA synthetic period) and beginning of mitosis) while most of an exponential control population is in G_1 (period between mitosis and DNA synthesis) and (2) the incorporation pattern differs in G_2 and G_1, the incorporation into HnRNA and polysomal mRNA being greater relative to that into informosomal messenger-like RNA in G_2 than in G_1. (NL)

24181 RESPONSES OF A RAT RHABDOMYOSARCOMA AND RAT SKIN TO IRRADIATION WITH GAMMA RAYS AND 15 MeV NEUTRONS AT LOW DOSE RATES. Kal, H. B. Amsterdam; Amsterdam Univ. (1974). 124p.

Thesis.

Factors were studied that influence cell survival in tumors and normal tissues during and after irradiation with gamma radiation and with 15-MeV neutrons at a low dose rate. The irradiation effectiveness was determined on a transplantable rhabdomyosarcoma and on the skin of the WAG/Rij rat. Repair of sublethal damage occurred during continuous gamma irradiation in vitro at low dose rates. During in vivo irradiation, this process is counterbalanced to increased radiosensitivity following reoxygenation of the tumor. In tumors the effectiveness for damage is 1.45 smaller for chronic than for acute irradiation in the case of gamma irradiation. For 15-MeV neutrons this factor is 1.1. The RBE of 15-MeV neutrons at 48 rad/h for the rhabdomyosarcoma is about 4.3 relative to ^{137}Cs gamma rays. The RBE of 15-MeV neutrons at 48 rad/h for damage to rat skin relative to ^{137}Cs gamma rays is about 2.7 at the 10% level. The therapeutic gain factor is 1.6, which is higher than the gain factor for acute irradiation, which lies between 1.1 and 1.3. These results suggest that the use of ^{252}Cf neutrons at low doses might be of advantage in radiotherapy. The use of multiple dose fractions, separated by a few hours as an alternative for continuous irradiation, is discussed. (NL)

24182 RADIATION INDUCED DNA DOUBLE STRAND BREAKS AND CHROMOSOME ABERRATIONS. Leenhouts, H. P.; Chadwick, K. H. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen (Netherlands)). Theor. Appl. Genet.; 44: No. 4, 167-172(1974).

7 figs.; 1 tab.; 31 refs.

Arguments are presented that favor an alternative approach to the interpretation of radiation-induced chromosome aberrations. Starting from the modern concept that a chromosome has a DNA double-stranded helix backbone and that the induction of DNA double strand breaks has a quadratic dose relationship, it is concluded that most chromosome aberrations arise from only one chromosome break. The direct correlation between chromosome aberrations and cell death derived from the model is demonstrated by the analysis of experimental results. The effect of dose rate, LET, and the occurrence of chromatid aberrations after irradiation in G1 are all logically explained by the theoretical model. (auth)

24183 NASCENT DNA SYNTHESIS IN ULTRAVIOLET LIGHT-IRRADIATED MOUSE, HUMAN, AND CHINESE HAMSTER CELLS. Rauth, A. M.; Tammemagi, M.; Hunter, G. (Univ. of Toronto). Biophys. J.; 14: No. 3, 209-220(Mar 1974).

The technique of alkaline sucrose gradient centrifugation was used to study newly synthesized DNA in control and ultraviolet light-irradiated mouse L, human HeLa, and Chinese hamster ovary cells. Nascent DNA molecular weight distributions did not appear to differ among the three cell lines for unirradiated cells. However, at short times after ultraviolet light irradiation, human HeLa cells appeared to synthesize more low molecular weight DNA than either mouse L or Chinese hamster ovary cells. Since this difference was not related to differences in either the rate of DNA synthesis or amount of ultraviolet damage in the irradiated cells it appeared to be a phenotypic characteristic of the cell lines tested. A parallel was noted for these three cell lines between an increase in the synthesis of low molecular weight DNA, detected on alkaline sucrose gradients, and cell killing as measured by the ability of irradiated cells to form colonies. (auth)

24184 RADIATION-INDUCED CHANGES IN THE DIVISION KINETICS OF THE LIEBERKUEHN CRYPT CELLS WITH SPECIAL RESPECT TO THEIR MIGRATION RATE INTO THE VILLI. Unger, E.; Varga, L. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszsegugyi Kutato Intezet, Budapest (Hungary)). Strahlentherapie; 147: No. 4, 426-431(Apr 1974).

3 figs.; 1 tab.; 11 refs.

The labelling and mitotic indices of Lieberkuehn crypt cells and their migration rate towards the villi were studied by ^3H-thymidine autoradiography in the small intestine of 250-R irradiated CFLP mice. Although, in spite of using animals from the same litter, the S. D. of the results obtained was rather high, a slight decrease of the migration rate as against the control could be demonstrated 12 hours after irradiation. Later on, the migration rate reached the control, then appreciably exceeded it at 72 hours and again approached the control values at even later dates. Assumedly, these changes in the migration rate might be correlated with the parallel changes of the mitotic index 10 to 48 hours earlier. No circadian alterations in the parameters studied could be demonstrated. (auth)

24185 DISTRIBUTION IN THE CELL CYCLE OF NORMAL CELLS AND OF IRRADIATED TUMOUR CELLS IN MICE. Raju, M. R.; Trujillo, T. T.; Mullaney, P. F.; Romero, A.; Steinkamp, J. A.; Walters, R. A. (Los Alamos Scientific Lab., NM). Brit. J. Radiol.; 47: No. 559, 405-410(Jul 1974).

Flow microfluorometry(FMF) instrumentation was used to make a rapid, quantitative measurement of the DNA content of individual cells from normal tissues and from KHT tumour cells of mice. These normal tissues are some of the limiting normal tissues in radiation therapy. The DNA content of tumor cells was also measured at different times after x-ray exposure. Preliminary results indicated that the cellular DNA content of all normal tissues was about the same and that a large fraction of cells was in the G_0 or G_1 stage. In the KHT tumor, nearly 75% of the cells were in the G_0 or G_1 stage, 20% in the S stage, and the remaining 5% in the G_2 + M stage. Ten hours after 300 rads of x rays, the number of tumor cells in the G_1 stage decreased to about 40%, cells in the G_2 + M stage increased to about 30%, and about 30% of the cells were in the S stage. The cellular DNA content was very nearly the same as unirradiated controls at 24 hours after exposure. When the tumors were exposed to 3,500 rads, at 24 hours after exposure the number of cells in the G_1 stage was reduced to 25%, the number of cells in the S stage remained nearly the same (25%), and the number of cells in the G_2 + M stage increased to about 50%. These studies indicate that FMF instrumentation can be a powerful tool to obtain quantitative information on DNA distribution of normal and tumor cell kinetics during radiation treatment. (auth)

24186 NO INTERACTION BETWEEN ULTRAVIOLET AND X IRRADIATION ON CHROMOSOME ABERRATIONS IN CELLS WITH TRISOMY 21. Holmberg, M. (Research Inst. of National Defense, Stockholm). Nature (London); 249: No. 5456, 448-449 (31 May 1974).

It was previously reported that uv irradiation of normal human lymphocytes immediately before or after x-irradiation gave rise to an approximately two-fold exercise in the frequency of dicentric chromosomes as compared with the yield induced by x rays alone. It is here reported that no synergistic effect was observed between uv and x rays in blood lymphocytes of individuals with Down's

syndrome (trisomy 21). This finding that the chromosome constitution influences the interaction between uv and x-irradiation is of interest since it was previously shown that cells with trisomy 21 have a higher sensitivity for chromosome breakage than normal cells after single irradiations with ^{60}Co γ rays or x rays. The irradiations were made at room temperature and the time between the uv and x-irradiations was <30 sec. The results could not be unambiguously explained. (UK)

24187 EFFECT OF THE MEDIUM ON POST-IRRADIATION CHANGES IN BULL SPERMS. Horakova, A. (Univ. of Veterinary Medicine, Kosice, Czech.); Horak, J. Folia Vet.; 15: No. 3-4, 77-81(1971). (In Slovak).

The effects of x radiation on exposed sperm re-suspended in non-irradiated media (nutrient plasma or saline) and on non-irradiated sperm re-suspended in irradiated media were studied. The radiation effects were most pronounced on exposed sperm suspended in the exposed medium; the effect decreased as a result of the re-suspension of exposed sperm in non-irradiated medium. X radiation was found to affect the bull sperm not only directly but also via the vehicle in which the sperm was suspended. (Nuclear Sci. Abstr. Czech.)

24188 EFFECT OF IRRADIATION WITH PROTONS OF 50 MeV ON THE AMOUNT OF CHROMOSOME ABERRATIONS IN LYMPHOCYTES FROM HUMAN PERIPHERAL BLOOD. Todorov, S. Eksp. Med. Morfol.; 11: No. 4, 220-226(1972). (In Russian).

Irradiation of lymphocytes from human peripheral blood with absorbed doses of 25, 50, 100, 250, and 500 rads of 50 MeV protons result in various chromosome aberrations such as chromosome fragments, rings, and cells with structural aberrations. The statistical elaboration of the experimental data after the method of the least squares yielded curves of regression for various chromosome disturbances, described by the mathematical models — $y = bD^n$ and $y = a + vD$. Comparative analysis of data on the amount of chromosome aberrations after irradiation with 50 MeV protons and 180 kV x rays showed RBE coefficients and 1.01 for cells with structural aberrations and 1.17 for chromosome fragments. (Abstr. Bulg. Sci. Med. Lit.)

24189 SURVIVAL OF L-CELLS FOLLOWING FRACTIONATED EXPOSURES TO ULTRAVIOLET LIGHT. Han, A. Iugoslav. Physiol. Pharmacol. Acta; 7: No. 2, 163-169(1971).

Survival resulting from two exposures, separated by various time intervals, is the same as that observed for cells exposed to a dose equal to the sum of two fractions. When the exposures are separated for more than four hours, cells display an increasing sensitivity to the second exposure. The survival pattern observed after fractionated exposures of uvl is very different from that described after fractionated exposures to x rays. The data indicate that cells surviving uvl irradiation do not repair their sublethal damage. (Bull. Sci. Sect. A)

24190 ROLE OF ANTIOXIDANT ACTIVITY IN NATURAL RADIOSENSITIVITY AND CHANGES THEREIN DURING THE CELL CYCLE. Bekeneva, G. P.; Merzlyak, M. N.; Parkhomenko, I. M.; Tarasenko, A. G. pp 40-45 of O Mekhanizmakh Prirod. I Modifitsor. Radiochuvstvitel'nosti. Moscow; Moscow State University (1973). (In Russian).

The antioxidant activity (AOA) of cultured monkey heart and monkey tonsil cells differing in sensitivity to x irradiation and of synchronously dividing sea urchin eggs was studied. The monkey cells were irradiated in a complete nutrient medium (100 to 600 R, dose rate 100 r/min) and the sea urchin eggs in the form of a thick suspension in seawater (1000 R 30 to 40 min after fertilization). The AOA of the monkey cells was evaluated using the method of recording ultraweak luminescence of the cells at 70°, while the AOA of the sea urchin eggs was judged from the capacity of extracted lipids to suppress the electrochemiluminescence of a saturated sodium citrate solution in methyl alcohol. A positive correlation was found between natural radiosensitivity and AOA. Addition to the medium of the antioxidant α-tocopherol at an effective concentration of 70 γ/ml 1½ hours prior to irradiation increased the radioresistance of the monkey heart cells. It was concluded that changes in AOA are one of the major factors responsible for changes in radiosensitivity. (Referativnyi Zh.)

24191 EFFECT OF X-IRRADIATION ON VARIOUS FUNCTIONS OF MURINE MACROPHAGES. Geiger, B.; Gallily, R. (Hebrew Univ., Jerusalem). Clin. Exp. Immunol.; 16: No. 4, 643-655(Apr 1974).

Unstimulated macrophages of x-irradiated mice have lost the capacity to induce an immune response to Shigella. Other studied functions of macrophages were unaffected or activated by x-irradiation. The phagocytic ability of irradiated macrophages, both in vivo and in vitro, was the same as that of normal cells. Irradiation of macrophage donors caused activation of several macrophage functions: DNA synthesis in irradiated macrophages was slightly higher, and RNA synthesis was six times higher than in non-irradiated controls. Choline uptake was significantly enhanced by irradiation. The levels of two lysosomal enzymes, acid phosphatase and cathepsin D, were elevated in macrophages taken from irradiated donors. The rate of particulate antigen (Shigella) degradation was slightly faster in irradiated macrophages, whereas no difference could be detected when soluble antigen ((T,G)-PRO--L) was employed. (auth)

24192 STUDIES OF LEUKEMIC CELL POPULATIONS IN CULTURE. Aye, M. T.; Niho, Y.; Till, J. E.; McCulloch, E. A., (Univ. of Toronto). Blood; 44: No. 2, 205-219(Aug 1974).

A suspension culture technique for the study of peripheral blood cells from patients with leukemia is described. Cells from patients in relapse were preserved by freezing with dimethylsulfoxide at −70°C to ensure the availability of the same population of cells for repeated experiments of varying designs. Cells from one AML patient proliferated only in the presence of phytohemagglutinin (PHA) or leukocyte-conditioned medium (LCM). Cells taken at a later date, after commencement of chemotherapy, failed to proliferate in response to PHA, although the responsiveness to LCM was retained. Proliferation of the cells obtained after chemotherapy could also be stimulated by culture supernatants from the original PHA-responsive cells. Eight other patients studied showed varying responses to LCM and PHA. It is proposed that cells from leukemic patients are made up of two interacting populations, one which produces stimulatory factors and another which responds to these factors by proliferation. Delineation of these two populations and the factors produced may provide a better understanding of leukemic cell proliferation. (auth)

24193 PROBLEMY RADIATSIONNOI TSITOLOGII. (PROBLEMS OF RADIATION CYTOLOGY). Tokin, I. B. Leningrad; Leningradskoe Otdelenie (1974). 319p.

Studies made by the author over a period of years on the action of radiation on cells and tissues are presented. In the first part are shown data, obtained by qualitative and quantitative methods using optical and electron microscopy (autoradiography, cyto- and immunochemistry, morphometry), on changes in the subcellular structure and cells of different types, population dynamics, proliferation activity, and nucleic acid synthesis. In the second part the most urgent morphological aspects of radiation medicine and biology are considered. The relation between cell resistance and structure is shown, factors are identified which determine the rate of cell and tissue repair, and problems of the relation of cell and tissue restoration are discussed. Mechanisms of cell repair are interpreted with consideration of experimentally observed relations between intracellular (reparative, mitotic) and extracellular types of biosynthesis. Questions of the action of radiation on the change in the level of cell differentiation and the role of the cell organelles in these processes are similarly clarified. Models are shown which calculate the possibility of submicroscopic reorganization of cells as a function of their stage in the life cycle. There are 101 figures, 9 tables, and a bibliography of 1256 entries. (tr-auth)

24194 IRREVERSIBLE LOSS OF NEGATIVE SURFACE CHARGE AND LOSS OF COLONY-FORMING ABILITY IN BURKITT LYMPHOMA CELLS AFTER X-IRRADIATION. Sato, C.; Kajima, K. (Aichi Cancer Center Research Inst., Nagoya, Japan). Exp. Cell Res.; 69: 435-439(Dec 1971).

The electrokinetic behavior of Burkitt lymphoma P3H-Rl cells were studied following x-irradiation. The surface charge of irradiated cells decreased progressively with time after x-ray treatment, as compared with a mean mobility value (−0.877 ± 0.045 $\mu sec^{-1}\ V^{-1}$ cm) of non-irradiated cells. The frequency distribution of cells treated with 3,000 R 4 h previously showed quite a different peak of lower mobility than that of non-irradiated cells with the boundary of −0.550 $\mu sec^{-1}\ V^{-1}$ cm. Percentages of cells which showed the higher mobility than the boundary value 4 h after irradiation with 30, 50, 65, 100, 200 or 3,000 R were in accord with the percentage of cells which showed colony-forming ability in soft agar, respectively. Following cell proliferation the population of electrokinetically intact cells increased with time after irradiation: these values also coincided with the population of colony-forming cells. Thus, the present results indicate that there is a close relation between loss of negative surface charge and loss of colony forming ability in irradiated cells, suggesting that loss of colony forming ability of the cells may be determined as early as 4 h after irradiation. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 24172, 24215, 24238, 24306, and 24354.

24195 (IAEA-R-846-F) CHARACTERIZATION OF USEFUL MUTATIONS IN FUNGI INDUCED BY RADIATION AND RADIOISOTOPES AND THE STUDY OF THEIR BIOSYNTHETIC PRODUCTS. Part of a Coordinated Programme on Radiation Microbiology. Final Report, 1 January 1970-31 December 1972. Chaudhuri, K. L. (International Atomic Energy Agency, Vienna (Austria)). Mar 1973. vp. INIS.

Citric acid biosynthesis by the strains of a fungal species Aspergillus niger, isolated from the soils of India, was investigated. X-ray and ultraviolet induced mutants of A. niger were selected for the capacity of increased citric acid yields. Suitable assay techniques for citric acid were developed, based on colorimetric and titration methods. A. niger mutants showing increased yields of citric acid in the culture filtrates were selected following both x rays (35 KR and 40 KR) and uv (24 minutes at dose rate of 100 ergs/mm^2/sec). Stepwise mutagenic treatments with x rays and uv alone or in combination gave further increase in citric acid yield, in some mutant strains. Chromatographic separation of the various organic acid intermediates of the tricarboxylic acid cycle in the citric acid producer and non-producer mutants provided some key information on the regulatory mechanisms of citric acid biosynthesis in A. niger. Genetic recombination between the improved mutants through planned breeding programmes for further strain improvements have met with some success and is being continued. (INIS)

24196 (JEN-283) BACTERIAL RADIOSENSITIVITY TO GAMMA AND ULTRAVIOLET. Compositional Dependence and Repair Mechanisms. Saez Angulo, R. M.; Davila, C. A. (Junta de Energia Nuclear, Madrid (Spain)). 1974. 171p. (In Spanish). Dep. NTIS (US Sales Only) $11.75.

The gamma and ultraviolet radiosensitivity of several species of bacteria was determined. Its dependence on DNA composition and repair processes was studied. Base composition was evaluated by chromatography, DNA melting temperature, and isopycnic sedimentation on CsCl gradient. Repair capacity of gamma- and uv-lesions was studied in two bacterial strains with the same DNA base composition. It is concluded that the postulated correlation between radiosensitivity and base composition cannot be generalized, the enzymatic repair mechanisms depending on radiosensitivity. (auth)

24197 (KURRI-TR-105, pp 26-30) CHEMICAL PROPERTIES AND BIOCHEMICAL SPECIFICITIES OF CELL DAMAGE FROM IONIZING RADIATION IN THE PRESENCE OF IODINE COMPOUNDS AND CELL RECOVERY. Kada, T. (National Inst. of Genetics, Mishima, Japan). 1972. (In Japanese).

Results are presented of investigations over the past several years on the lethality, mutation, and recovery of Bacillus subtilis irradiated with γ rays in the presence of iodine compounds. Without iodine compounds, Bacillus subtilis showed a single-hit lethal curve from gamma-irradiation, while in the presence of iodine compounds the radiosensibility of the strain increased and a multihit death curve was obtained. When the pH of the iodine compounds became acidic (approximately pH 5.4) at the time of irradiation, the degree of radiosensitization increased markedly. Synthesis of DNA was markedly inhibited in Bacillus subtilis cultured after radiation with a low concentration of the drug and moderate degree of radiosensitization compounds. However, the synthesis of high molecules, such as protein and DNA, was completely inhibited, when the concentration of the drug was high with large fluctuations in mortality. In those bacterial cells moderately radiosensitized, the incidence of mutant bodies decreased markedly. In cells of Bacillus subtilis moderately radiosensitized with potassium iodate, no rejoining of DNA single-strand breaks was observed during the period of culture after radiation. Radiosensitization of cells with iodine compounds was not considered to be caused by qualitative changes or a quantitative increase in damages of DNA due to irradiation. The causative factors of cellular toxicity were produced during gamma-irradiation at 0°C in the presence of iodine compounds dissolved in phosphate buffer (pH 5.4). These products were stable at low temperature and act specifically with SH materials. Cells added to these toxic products were killed immediately. Mutant strains of Escherichia coli possessing resistance to radiation-produced toxicity were classified. They were resistant in neutral and acidic conditions, but were not resistant to the iodine in potassium iodate. (JA)

24198 ULTRAVIOLET INACTIVATION OF THE ABILITY OF E. COLI TO SUPPORT THE GROWTH OF PHAGE T7: AN ACTION SPECTRUM. Day, R. S.; Muel, B. (Institut du Radium, Paris). Photochem. Photobiol.; 20: No. 2, 95-102(Aug 1974).

The action spectrum for inactivation of the capacity of stationary-phase Escherichia coli B to support the growth of T7 bacteriophage was measured, using radiation 240-405 nm in wavelength. The action spectrum has a minimum at 254 nm, a maximum at 267 nm, and a shoulder between 313 and 334 nm, followed by a decrease at longer wavelengths, indicating that nucleic acid is probably not the target for capacity inactivation. Deoxycytidine, cytidine, thiamine, and some proteins have absorption spectra similar to the far-ultraviolet (240-300 nm) portion of this action spectrum. (auth)

24199 INACTIVATION OF A2-HONG KONG INFLUENZA VIRUS BY HEAT AND BY FREEZE-THAWING. Comparison of Untreated and Gamma-Irradiated Preparations. De Flora, S.; Bandolati, G. (Univ., Genoa). Boll. Ist. Sieroterap. Milan.; 52: 293-305(1973).

The stability of untreated and of γ-irradiated A2/Aichi/2/68 influenza virus was checked during a 2-year storage at temperatures ranging from -80 to +37°C and after heating at +56°C. The following conclusions could be drawn: hemagglutinin and neuraminidase activities were not impaired by exposure to 3×10^6 rad of cobalt-60 γ rays, whereas infectivity was completely abolished; at -80°C no decrease of infectivity of untreated virus nor of surface antigens activity of both the untreated and the irradiated preparations was detectable; from -20 to +37°C the inactivation of both preparations followed first-order kinetics, the velocity constants (k) showing very low values, particularly for hemagglutinin activity; conversely, at +56°C the inactivation of all virus properties took place in two stages, each following first-order kinetics; the inactivation constants of hemagglutinin and neuraminidase properties of untreated and irradiated preparations were overlapping when samples were stored in the frozen state (-80 and -20°C); on the contrary, a significantly increasing rate of inactivation was observed for irradiated virus antigens after storage at temperatures above +4°C; the same phenomenon was recorded after periodical thawing at +20°C of virus preparations stored at -20°C (30 cycles of freeze-thawing in 2 years); the above mentioned differences did not depend on a modified protective action of the irradiated medium; nevertheless, the thermal stability of irradiated non-infective particles was considerable in view of practical applications, as inferred by the calculation of the thermodynamic parameters of inactivation; in fact, the energy of activation (ΔH) needed for the thermal inactivation of virus properties was very low and the entropy of activation (ΔS) had negative values for both the untreated and the irradiated virus samples. (auth)

24200 MUTAGENIC EFFECT OF SECONDARY IRRADIATION FROM PROTONS OF 70 GeV. Akoev, I. G.; Yurov, S. S.; Leont'eva, G. A.; Kuzin, A. M.; Livanova, I. A.; Lebedev, V. I.; Lukanin, V. S. (Inst. of Biological Physics, Puscino, USSR). Stud. Biophys.; 41: No. 3, 167-180(1973). (In Russian).

Findings on the high relative genetic effectiveness of the secondary radiation of 70 GeV protons and on the differences of the spectrum of r-mutants are reported. Reversions of rII-mutants of T4B bacteriophage under the influence of chemical mutagens in comparison with control irradiation with γ-ray ^{137}Cs are described. It is explained by the characteristic features of strong interaction of high energy hadrons. Such characteristic features are the great extent of generation of secondary particles, including multicharged fragments and antiprotons, their narrow angle distribution, some definite possibility of nuclear interaction with any atom of the DNA molecule. The molecular-specific characters of hadron mutagenesis are suggested. (auth)

24201 SELECTION AND CHARACTERIZATION OF ESCHERICHIA COLI MUTANTS ALTERED IN PROTEIN SYNTHESIS. Lupker, J. H. Leiden; Rijksuniversiteit (1974). 78p. Thesis.

A new selection method for the isolation of mutants of Escherichia coli, altered in protein synthesis, was developed. The rationale of this method is that cells unable to propagate the RNA phage MS2 at 42°C may contain a lesion affecting protein synthesis. The selection was performed by infecting mutagenized E. coli cells with highly ^{32}P-labelled MS2 at 42°C. After the infection the cells were stored at -80°C for 60 days and subsequently plated at 28°C. Cells in which the MS2-RNA was replicated during the initial incubation at 42°C were killed by radiolysis. Six out of ten desintegrations were efficient in killing phage MS2. By this method enrichment by a factor 180 could be achieved. The strains QL 152 and QL 199 were analyzed in detail for thermosensitivity of growth and of protein synthesis. QL 152 showed a thermosensitive protein synthesis when studied with MS2-RNA as messenger. In vivo protein synthesis of QL 199 was thermosensitive; in vitro protein synthesis was not thermosensitive. A mutant of QL 199 was also investigated; it was demonstrated that the molecule EF-Tu, serving as an elongation factor, has at least three sites that are involved in the elongation factor. (NL)

24202 STUDIES OF THE FOOT-AND-MOUTH DISEASE VIRUS SUB-TYPES USING ANTIGENS INACTIVATED BY GAMMA

RADIATIONS. Frescura, T.; Vivoli, P. (Istituto Zooprofilattico Sperimentale dell'Umbria e delle Marche, Perugia (Italy)). Zentralbl. Veterinaermed., Reihe B; 20: No. 10, 822-825(Dec 1973). 1 fig.; 2 tabs.

The complement fixing property of lyophilized FMD virus after gamma radiation treatment was studied. The in vitro antigenicity of lyophilized O_1, O_2, O_7 FMD virus is not affected. The results obtained show a sub-type specificity and no significant differences were observed for the values obtained using non-inactivated antigens and gamma-inactivated antigens. (auth)

24203 ULTRAVIOLET-ENHANCED REACTIVATION OF HERPES VIRUS IN HUMAN TUMOR CELLS. Lytle, C. D.; Benane, S. G.; Bockstahler, L. E. (Bureau of Radiological Health, Rockville, MD). Photochem. Photobiol.; 20: No. 2, 91-94(Aug 1974).

Virus-host cell interactions may be investigated by study of the enhancement of infectivity of uv-irradiated virus obtained by uv-irradiating the host cell [ultraviolet reactivation (UVR)]. This phenomenon was studied with Herpes simplex virus and normal (embryonic lung) and malignant (HeLa) human cells. Although the lung cells displayed no UVR, both the HeLa cells and a Sendai-virus carrier culture of HeLa cells demonstrated UVR capabilities. This UVR persisted at equal or increased levels for at least 24h. Since the lung cells and HeLa cells have similar host-cell-reactivation (HCR) abilities, the differences in UVR suggest that UVR and HCR may operate by different mechanisms. (auth)

24204 RESPIRATION AND METABOLIC PROCESSES OF BACTERIA IN AUTOCLAVED AND GAMMA-IRRADIATED SOIL. Kunc, F. (Inst. of Microbiology, Prague). Bull. Astron. Inst. Czech.; 25: No. 3, 218-228(1974).

Samples of chernozem and brown soils were irradiated with gamma rays using doses of 1.5 to 4.5 Mrad or fractionally autoclaved at 1 and 2 kp/cm^2. Consumption of oxygen by cellular suspensions of bacteria added to suspensions of sterilized soils was higher than in untreated samples. The increased oxygen consumption indicated an increase in the quantity of a biologically oxidizable substrate which could be released during the irradiation or autoclaving of soils. The amount of oxygen consumed was proportional to the radiation dose or autoclaving time and the pressure used and was dependent also on the type of soil. The accessible substrate could be immediately, without a lag phase, oxidized by the added microorganism. The extent and rate of oxygen consumption in the sterilized soil samples varied in different microorganisms It was observed that decomposition of vanillic acid by a cell suspension of Cellulomonas sp. was stimulated in the soil sterilized by radiation. The significance of these findings for the soil metabolic studies is discussed. (auth)

24205 VARIABILITY IN AMYLASE PRODUCTION AMONG MORPHOLOGICAL MUTANTS OF ASPERGILLUS WENTII. Basu, S.; Chakrabarty, S. L. (Bose Inst., Calcutta). Bull. Astron. Inst. Czech.; 25: No. 3, 199-202(1974).

Mutational experiments were performed to produce morphological mutants from Aspergillus wentii Wehmer (IMI 17295) by uv and x-ray irradiation. Among the morphological mutants, five representative types were recognized. Marked variation existed in amylase activity between the morphological mutants and the wild type. (auth)

24206 COMBINED EFFECT OF SOME IODINE COMPOUNDS AND ^{137}Cs γ-RAYS ON YEAST CELLS. Seliverstova, L. A.; Vakina, I. P.; Meissel, M. N.; Mokhnach, V. O. (Inst. of Microbiology, Moscow). Izv. Akad. Nauk SSSR, Ser. Biol.; No. 1, 129-131(Jan 1974). (In Russian).

The combined effect of ^{137}Cs γ radiation and iodine preparations containing iodine in an oxidation state, i.e., in the I^{1+} form, was studied on the survival of the yeasts Saccharomyces vini of the Megri 139V strain. The experimental results showed that both preparations iodine–potassium iodide and iodinol have sensitizing properties. The sensitizing effect is increased with increase of the radiation dose and the concentration of the iodide compounds. The sensitizing effect of iodine–potassium iodide is significantly lower than the effects of iodinol, a compound of iodine–potassium iodide with poly(vinyl alcohol). (tr-auth)

24207 RADIOSTERILIZATION OF PLASTIC, DISPOSABLE, MEDICOSURGICAL APPARATUS AND ADJUNCTS: BACTERIOLOGICAL CONTROL. Benazet, F.; Godard, C. (Societe des Usines Chimiques Rhone-Poulenc, Vitry-sur-Seine, France). Ann. Pharm. Fr.; 32: No. 1, 25-35(1974). (In French).

Study of the bacteriological problems raised by the radiosterilization (by means of γ rays and electrons) of plastic disposable medicosurgical apparatus and adjuncts to the exclusion of the problems pertaining to packaging. Survey of the characteristics of sterilization by means of ionizing radiations: inactivation curves, inactivation factors, margin of safety, biological indicators. Review of the main foreign regulations (Code of Practice of the International Atomic Energy Agency of Vienna, Danish regulation, United States Pharmacopeia) and discussion of the solutions recommended as regards initial contamination of manufactured articles, source efficiency control, choice of dose, control of the efficacy of irradiation procedure and control of the sterility of irradiated articles. According to these regulations and experience, the basic principles which are to be taken into consideration for the use of radiosterilization when official directives are lacking are stated: bacteriological cleanness of premises and of the articles upon handling, manufacturing and assembling, control of the bactericidal efficiency of radiation source, minimal dose of 2.5 Mrad distributed as evenly as possible, control of the efficacy of each routine operation of sterilization by means of physicochemical dosimetry and biological indicators. (FR)

24208 MANIFESTATION OF CHROMOSOME REARRANGEMENTS IN UNORDERED ASCI OF NEUROSPORA. Perkins, D. D. (Stanford Univ., CA). Genetics; 77: No. 3, 459-489(Jul 1974).

Rapid, effective techniques were developed for detecting and characterizing chromosome aberrations in Neurospora by visual inspection of ascospores and asci. Rearrangements that are detectable by the presence of deficient, nonblack ascospores in test crosses make up 5 to 10% of survivors after uv doses giving 10 to 55% survival. Over 135 rearrangements were diagnosed by classifying unordered asci according to numbers of defective spores. (These include 15 originally identified or analyzed by other workers.) About 100 reciprocal translocations (RT's) have been confirmed and mapped genetically, involving all combinations of the seven chromosomes. Thirty-three other rearrangements generate viable nontandem duplications in meiosis. These consist of insertional translocations (IT's) (15 confirmed), and of rearrangements that involve a chromosome tip (10 translocations and 3 pericentric inversions). Asci are shot spontaneously from ripe perithecia, and can be collected in large numbers as groups of eight ascospores representing unordered tetrads, which fall into five classes: 8B:0W; 6B:2W, 4B:4W, 2B:6B, 0B:8W. In isosequential crosses, 90 to 95% of tetrads are 8:0. When a rearrangement is heterozygous, the frequencies of tetrad classes are diagnostic of the type of rearrangement, and provide information also on the positions of break points. With RT's, 8:0 (alternate centromere segregation) = 0:8 (adjacent-1), 4:4's require interstitial crossing over in a centromere–break point interval, and no 6:2's or 2:6's are expected. With IT's, duplications are viable, 8:0 = 4:4, 6:2's are from interstitial crossing over, 0:8's or 2:6's are rare. Tetrads from RT's that involve a chromosome tip resemble those from IT's, as do tetrads from intercrosses between partially overlapping RT's that involve identical chromosome arms. Because viable duplications and other aneuploid derivatives regularly occur among the offspring of rearrangements such as insertional translocations, care must be taken in selecting stocks, and original strains should be kept for reference. (auth)

24209 COMPARISON BETWEEN IRRADIATED AND AUTOCLAVED DIETS FOR BREEDING MICE, WITH OBSERVATIONS ON PALATABILITY. Porter, G.; Festing, M. (Medical Research Council Lab. Animals Centre, Carshalton, Eng.). Lab. Anim.; 4: 203-213(Oct 1970).

Two commercial laboratory mouse diets were sterilized by either high-vacuum autoclaving or gamma irradiation, and then fed to breeding mice of 2 different strains housed as monogamous pairs or trios. There was a statistically significant diet-by-sterilization-method interaction for total number of mice weaned, although neither the effect of diet nor sterilization method was statistically significant. Thus with diet FFG an average of 45.1 young was weaned per cage on irradiated diet compared with 55.6 on the autoclaved diet, while 51.4 mice were weaned per cage on irradiated Breeding Diet compared with 47.6 on the autoclaved. This result suggests that the effects of sterilization by either method depend on the nature of the diet, so that it should be possible to design diets capable of being sterilized by autoclaving or irradiation. Palatability trials indicated a strong preference for irradiated diet over autoclaved diet. (auth)

24210 UV-INDUCTION OF ADENINE-DEPENDENT MUTANTS IN SCHIZOSACCHAROMYCES OCTOSPORUS. Kosikov, K. V.; Zapadnaya, A. A. (Inst. of General Genetics, Moscow). Genetika; 10: No. 6, 89-93(Jun 1974). (In Russian).

Red and purple adenine-dependent mutants (ad$^-$) were obtained in Schizosaccharomyces octosporus. uv-Radiation was used as a mutagen. Beforehand a dependence curve culture of Sch. octosporus 12 survival on the effect of uv at different doses of irradiation was taken. It was proved experimentally that on reaching 2.9% survival of cells the frequency of induction of colored ad-mutants was about 3.9×10^{-5}. (auth)

24211 UV-INDUCED MUTAGENESIS IN ESCHERICHIA COLI MUTANTS polA1 AND uvrE502 DEFICIENT IN THE RESYNTHESIS STEP OF EXCISION REPAIR OF DNA. Skavronskaya, A. G.; Smirnov, G. B. (Inst. of Epidemiology and Microbiology, Moscow). Genetika; 10: No. 6, 102-113(Jun 1974). (In Russian).

UV-induced revertions to prototrophy were studied in the set of isogenic strains carrying trpA58 and differing in polA and uvrE alleles. It was found that the frequency of uv-induced Trp^+ revertants was higher in the uvrE502 mutant than in the wild type strain or in polA1 mutant irradiated with the same uv-doses. Taking into account the reduced ability of the polA1 and uvrE502 mutants to complete excision repair, one might expect selective surviving of cells receiving minimal number of uv-damages, which is considerably less than that critical for wild type cells. In this case uv-survivals of polA1 and uvrE502 should exhibit lower mutability, than the wild type cells. However, this was not found to be the case. It is assumed that one possible explanation of this contradiction is that in the absence of DNA polymerase I or $uvrE^+$ gene product the r.pair replication in survival occurs with a higher probability of errors than that in wild type cells. (auth)

24212 ROLE OF ATP IN EXCISION REPAIR OF ULTRAVIOLET RADIATION DAMAGE IN ESCHERICHIA COLI. Waldstein, E. A.; Sharon, R.; Ben-Ishai, R. (Israel Inst. of Tech., Haifa). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 7, 2651-2654 (Jul 1974).

The effect of ATP on the first step of excision repair of ultraviolet damage in DNA has been studied using toluene-treated E. coli. During postirradiation incubation, five to six times more single-strand breaks are formed in DNA in the presence of exogenous ATP than in its absence. The ATP-dependent as well as the ATP-independent endonucleolytic activities appear to be catalyzed by the same enzyme since both activities are almost completely absent in uvrA and uvrB mutants. An ATP-dependent endonucleolytic activity has been detected in nonirradiated toluene-treated E. coli. It is concluded that ATP is required in vivo for either the incision step of repair or an enzymatic reaction preceding it. (auth)

Radiation Effects on Plants

Refer also to abstracts 24143, 24410, 26194, and 26225.

24213 (BNL-50410) BASIC MECHANISMS IN PLANT MORPHOGENESIS. Report of Symposium Held at Upton, New York, June 4-6, 1973. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. Contract AT(30-1)-16. 434p. (CONF-730643-). Dep. NTIS $10.60.

Emphasis of the symposium was placed on the phenomenology of the morphogenetic process and on potentially new modes of experimental analysis with an emphasis on genetic techniques. (MCG)

24214 (COO-2283-4) RESPONSE OF A FOREST ECOTONE TO IONIZING RADIATION. Progress Report, October 15, 1973-October 14, 1974. Murphy, P. G. (Michigan State Univ., East Lansing (USA)). 1974. Contract AT(11-1)-2283. 20p. Dep. NTIS $4.00.

Compositional and structural characteristics of three forest types, including aspen dominated, maple-birch dominated, and an intervening ecotone, were studied before and after irradiation in northern Wisconsin. Preirradiation findings are reported in papers by Murphy and Sharitz (1974) and Murphy, Sharitz, and Murphy (1974). Irradiation occurred during the summer of 1972. Preliminary data indicate that by the summer of 1973 the density of viable tree seedlings at 10 m from the radiation source was substantially reduced in all three areas relative to the preirradiation densities of 1971. At 20 m and beyond, the density of seedlings in the three areas increased during the period between 1971 and 1973. The overall density of seedlings of Populus tremuloides and Acer rubrum increased markedly in the three areas and P. tremuloides invaded some areas in which it had not been found prior to irradiation. The density of viable trees greater than 2.5 cm d.b.h. decreased sharply at 10 m in the aspen area and ecotone but decreased only slightly in the maple-birch area where all Acer rubrum and Betula papyrifera in the 10 m transect were still viable in 1973. Leaf litter production was reduced by up to 94% at 10 m and 64% at 20 m during the period between 1971 and 1973 in the irradiated areas. Leaf litter production was most severely reduced in the aspen area. The overall increase in seedling density at 20 m from the radiation source and beyond may be associated with the opening of the canopy as evidenced by the reduction in leaf litter production. The rate and compositional characteristics of succession in the ecotone relative to aspen and maple-birch forest types is presently under study. (auth)

24215 (JPRS-62553, pp 7-13) EXPERIMENTAL DATA ON THE INFLUENCE OF IRRADIATION OF FOOD PRODUCTS BY PROTONS AND GAMMA RADIATION. Bychkov, V. P.; Kozar, M. I.; Popov, V. I.; Boyko, N. N.; Kolchin, E. V.; Khokhlova, O. S.; Yurgov, V. V. 24 Jul 1974. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 6-10(1974).

The effect of proton and γ irradiation at doses of 1.5 and $7.0 \cdot 10^4$ rad on sunflower oil, vitamin concentrates, dry milk, and dry brewer's yeast are reported. The results are included of a study of the amino acid composition, vitamin content, and decomposition of these products with pancreatin and lipase in vitro. The irradiation of these products decreased the content of vitamins and decomposition of sunflower oil with lipase and deterioration of the organoleptic properties of irradiated milk during storage. (auth)

24216 INDUCED MUTATION IN TOMATO BY PRE-IRRADIATION TREATMENT WITH COLCHICINE AND DIETHYL SULPHATE. Bose, S.; Maiti, S. N. (Univ. of Calcutta). Nucleus (Calcutta); 16: No. 1, 41-43(Apr 1973).

Tomato seeds were treated with distilled water, colchicine, and diethyl sulphate and x-irradiated in doses of 10, 20, 30, and 40 kR. Results showed that germination decreased with increase in radiation dose. The maximum number of chromosomal aberrations occurred following treatment with DES and a 40 kR radiation dose, and the maximum number of mutations occurred following DES and a 20 kR dose. (HLW)

24217 SCREENING OF CROP PLANTS FOR RADIATION INDUCED STIMULATION. P. 1. Kidney Bean, Onion and Lettuce. Gaur, B. K.; Desai, B. M. (Bhabha Atomic Research Centre, Bombay (India). Biology and Agriculture Div.). Stimulation Newslett.; No. 3, 13-16(Dec 1971).

2 tabs.; 3 refs.

Seeds of the 3 species were irradiated with 100-5,000 R of x rays and sown within 2 hrs post-irradiation. In kidney beans, only 5,000 R increased significantly the pod number per plant and the number of seeds per mature pod. In onions, all doses except the highest one improved the bulb size. In contrast, results on lettuce did not reveal any significant effect on the number or fresh weight of leaves. (GE)

24218 EFFECTS OF X RAYS ON ROOTING RESPONSE OF CUTTINGS. Preliminary Results. Zimmer, K.; Altan, S. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Zierpflanzenbau); Bors, J.; Fendrik, I. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Biophysik). Stimulation Newslett.; No. 3, 7-12(Dec 1971).

4 tab.; 2 refs.

Cuttings of various horticultural plants were irradiated with 10 to 10,000 r of x rays or ^{60}Co γ rays and planted into pots. The number of roots per cutting and the length of the main roots were recorded daily or at the end of the experiment. Low doses increased the rooting significantly in 4 of the 6 species tested, while one indicated a suppression of root formation. The sensitivity to higher doses and the root growth was very different in the 6 species. A significant decrease of root length occurred in the same dose range as the decrease of root numbers. (GE)

24219 RADIOSTIMULATION EXPERIMENTS ON EARLY RED RADISH. Balint, A.; Simon, J.; Menyhert, Z.; Viglasi, P.; Pannonhalmi, K. (Agrartudomanyi Egyetem, Godollo (Hungary). Dept. of Plant Breeding). Stimulation Newslett.; No. 3, 41-48 (Dec 1971).

5 tabs.

Irradiation of dry seeds was performed with 300 to 3,000 rads of ^{60}Co γ rays. The seeds were sown in a greenhouse or in the open field. Following parameters were investigated: germination, height, number of leaves, root diameter, total weight, root weight, dry matter content, water-soluble carbohydrates and vitamin C content. No radioinduced stimulation of germination was found. The leaf number and the dry matter content was lessened as compared with the controls. A radioinduced stimulation was found in root diameter, root weight, total weight, and water-soluble carbohydrate content. The greatest positive effect was observed in the vitamin C content. In nearly all cases some differences were found between greenhouse and open field experiments. (GE)

24220 DELAYED EFFECTS OF IONIZING RADIATION. P. 3. Stimulation Effects on Fruit Number, Fruit Size and Seed Number in two Tomato Varieties After Exposure of Seeds of the Parental Generation to a High X-Ray Dose (40 kR). Schwanitz, F.; Schwanitz, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Botanik und Mikrobiologie; Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Medizin). Stimulation Newslett.; No. 3, 2-6(Dec 1971).

3 tabs.

In the variety "Rheinland Ruhm" the irradiation of parental generation is found to increase the numbers of fruits by about 74%, the average weight of fruits is decreased by 24%. The fruit

production in g/plant is therefore enhanced by about 32%. In the variety "Prof. Rudloff" the average number of fruits was increased by 34%, the average fruit weight decreased by 10%. The fruit production is therefore by about 20% higher than in the parental generation. If the same variety was transferred to larger pots the resulting values were 94% increase of fruit number and 21% decrease of fruit weight. (GE)

24221 NITROGEN CONTENT OF TWO SPRING WHEAT VARIETIES AS AFFECTED BY SEED IRRADIATION. Haunold, E.; Zvara, J. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Stimulation Newslett.; No. 3, 30-36 (Dec 1971).

5 figs.; 2 tabs.; 4 refs.

In two consecutive years seeds in an air dried state received a total dose up to 5,000 and 10,000 rads of γ rays. The time between irradiation and sowing was 1 d. The pots received 0.5 or 1.0 gN. Top dressing in general increased the yield, while basic dressing showed different result for both years. Differences were found too as far as the nitrogen content of the kernels is concerned, in the 2nd year the nitrogen content increased from 100 rads on upwards. (GE)

24222 MECHANISM OF X-RAY-INDUCED GROWTH STIMULATION. Feldmann, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Botanik und Mikrobiologie). Stimulation Newslett.; No. 3, 37-40(Dec 1971).

4 refs.

A review is given of the results of experiments on the dependence of radioinduced growth stimulation in Lemma minor depending on external factors such as light and temperature. Results of experiments in which irradiation time was shifted over the photoperiod are reported. A short interruption of the constant culture conditions with photoperiods of 12 or 16 hrs reduced the growth and more so, as the interruption came later in the photoperiod. In plants with a 6-hr daylight period a reversed trend was found. The interruption of the constant environmental conditions in some cases led to a stimulation, in other to a depression of growth. However, in all experiments mitotic activity was at first reduced. (GE)

24223 THE RELATION BETWEEN SEED IRRADIATION, FERTILIZER LEVEL AND YIELD OF SPRING BARLEY. Suess, A.; Grosse, W. (Bayerische Landesanstalt fuer Bodenkultur, Pflanzenbau und Pflanzenschutz, Muenchen (F. R. Germany)). Stimulation Newslett.; No. 3, 22-29(Dec 1971).

2 figs.; 6 tabs.

Seeds with 10 to 12% water content were irradiated 1 d before sowing with 1 to 10,000 R. Two fertilizer levels (normal and deficient) were applied 10 d after emergence. In the deficient fertilizer series irradiation doses of 1,000 and 2,500 R caused an increase in grain yield. In the case of a normal fertilizer level the average grain yield was reduced after 100, 5,000, and 10,000 R. The radiation effect on straw yield did not show a clear relationship to fertilizer level. As to grain weight and number of grains per ear, no real differences in both treatments were observed. After doses of 2,500, 5,000, and 10,000 R a tendency toward a higher straw yield was found. (GE)

24224 STUDY OF INTERACTION OF "LOW" DOSE OF RADIATION WITH PRESOAKING OF SEEDS ON THE YIELD OF SPRING BARLEY "IMPALA". Fendrik, I.; Bors, J. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Biophysik). Stimulation Newslett.; No. 3, 17-19(Dec 1971).

1 fig.; 1 tab.

Experiments were carried out in pots, both in the open air and in the greenhouse. Seeds were soaked for 6 hrs prior to irradiation. A broad dose range from 250 to 10,000 R was used with a dose rate 600 R/hr. The highest increase in kernel yield in the open air experiment was found at 1,000 R, in the greenhouse experiment both at 500 and 1,000 R. (GE)

24225 CHANGES IN QUANTITATIVELY INHERITED TRAITS IN RADIATED AND NONRADIATED BULK OAT (AVENA SATIVA L.) POPULATIONS. Fatunla, T.; Frey, K. J. (Iowa State Univ., Ames). Egypt. J. Genet. Cytol.; 3: No. 2, 259-276(Jul 1974).

An oat bulk population, made by mixing F_2 seeds of approximately 250 crosses, was divided into two lines of descent: one received seed radiation with thermal neutrons or x rays for four consecutive generations ($F_3 - F_6$) and was then propagated en masse through F_{11}, and one was propagated en masse without radiation treatment from F_3 through F_{12}. Forty random oat lines (each from a single plant) from each of F_3, F_4, F_6, F_8, F_{10} and F_{12} of the nonradiated and F_4, F_6, F_8, F_{10}, and F_{11} of the radiated line of descent were grown in a five-replicate experiment at Ames, Iowa. Traits measured were grain yield, bundle weight, harvest index, seed number per plot, 100-seed weight, plant height, and heading date. The radiation treatments increased the outcrossing among plants that originated from the radiated seeds, but neither the outcrossing nor the mutations that may have been induced by the radiation treatments materially expanded the genotypic variation for any trait. In other words, the genotypic variances for both lines of descent were about equal. Natural selection caused changes in the means of yield, bundle weight, seed number per plot, and plant height in both lines of descent. Nearly the total change from this phenomenon occurred between F_3 and F_4 of the nonradiated line of descent, whereas the changes in means were more gradual in the radiated one. For 100-seed weight, harvest index, and heading date, the means remained similar across generations. By the latest generations tested (i.e., F_{12} of nonradiated and F_{11} of radiated), the means for each trait were approximately equal in the two lines of descent. (auth)

24226 EFFECTS OF SINGLE AND COMBINED TREATMENTS OF GAMMA-RAYS AND EMS ON THE M_1-FERTILITY AND M_2-CHLOROPHYLL MUTATIONS IN VICIA FABA L. Hussein, H. A. S.; Abdalla, M. M. F. (Univ. of Cairo, Giza, Egypt). Egypt. J. Genet. Cytol.; 3: No. 2, 246-258(Jul 1974).

Seeds of the two field bean varieties, Giza-2 and Rabaya-40, were treated with gamma rays or ethyl methanesulphonate (EMS). In addition, seeds from the variety Giza-2 were treated with combinations of both mutagens. Fertility of M_1-plants was affected. The least effect was shown by gamma-ray treated material, while EMS was relatively more effective. The combined mutagenic treatments gave the greatest effect in M_1, but not on M_1-fertility. In M_2 generation, no chlorophyll mutant seedlings could be detected in the gamma-treated populations. EMS and the combined treatments induced the 3-chlorophyll mutations: Viridis, Xantha and Albina. The higher the EMS concentration applied, the higher was the chlorophyll mutation frequency obtained. The combined treatments resulted in about doubling the mutation frequencies compared to those of EMS alone. It was concluded that the variety Giza-2 is relatively more radio-resistant, while Rebaya-40 is relatively more EMS-sensitive, and that preirradiation of EMS-treated material may stimulate mutational events. (auth)

24227 EMS- AND GAMMA-RAY-INDUCED MUTATIONS IN PISUM SATIVUM L. II. Effects of EMS and Gamma-Rays on M_1-Germination, Seedling Height, and Fertility. Selim, A. R.; Hussein, H. A. S.; El-Shawaf, I. I. S. (Univ. of Cairo, Giza, Egypt). Egypt. J. Genet. Cytol.; 3: No. 2, 172-192(Jul 1974).

Seeds of two pea varieties were treated with different EMS concentrations, γ doses and the combination of both. Responses in M_1-generation (germination, seedling height and fertility) were studied. Increasing the mutagen dosage caused almost a linear reduction in M_1-performance. EMS caused a relatively higher degree of M_1-sterility than γ-rays. Pre-treatment with EMS before irradiation caused almost complete lethality, while post-treatment with EMS after irradiation enhanced seed lethality and reduction of seedling growth, but caused additivity effects on fertility. Varietal differences in mutagen-sensitivity were discussed. (auth)

24228 MUTAGENIC EFFECT OF N-NITROSO-N-METHYLUREA APPLIED ALONE AND COMBINED WITH ULTRAVIOLET IRRADIATION ON CHLAMYDOMONAS REINHARDTII DANG. CELLS. Podstavkova, S.; Miadokova, E.; Thi Hoa, T. (Komensky Univ., Bratislava). Biologia (Bratislava); 28: No. 6, 469-476(1973). (In Slovak).

The effect was studied of various concentrations of N-nitroso-N-methylurea applied alone or combined with 10 seconds of ultraviolet irradiation on genetic changes (pigment mutations, morphological changes, microcolonies, lethal and double mutations) in Chlamydomonas reinhardtii Dang. cells. Additional irradiation of the cells previously treated with N-nitroso-N-methylurea was found to increase the mutagenic effect of the mutagen. (Nuclear Sci. Abstr. Czech.)

24229 PHYSIOLOGICAL RESPONSE OF CHLAMYDOMONAS REINHARDTII DANG. CELLS TO TREATMENT WITH N-NITROSO-N-METHYLUREA AND ULTRAVIOLET RADIATION. Miadokova, E.; Podstavkova, S.; Thi Hoa, T. (Komensky Univ., Bratislava). Biologia (Bratislava); 28: No. 6, 451-462(1973). (In Slovak).

The effect of ultraviolet radiation alone and the effect of N-nitroso-N-methylurea applied in combination with a low dose of ultraviolet radiation were studied on the survival, on the number of zoospores produced during the first division, and on the lag phase of the cells of Chlamydomonas reinhardtii Dang. N-nitroso-N-methylurea and ultraviolet radiation in combination had a higher inhibitory effect on the nuclear and the cellular division than the chemical or the physical mutagen alone. This was shown by the reduction of multispore types and the extension of the lag phase. The combined application of N-nitroso-N-methylurea and ultraviolet radiation also resulted in a higher death rate. (Nuclear Sci. Abstr. Czech.)

24230 TOXIC AND GENETIC FACTORS LIMITING THE INCREASE OF MUTATION FREQUENCY AFTER TREATMENT WITH ALKYLATING NITROSO-COMPOUNDS AND X-RAYS ON ARABIDOPSIS SEEDS. Gichner, T.; Veleminsky, J. (Inst. of Experimental Botany, Prague). Biol. Plant. (Prague); 15: No. 5, 350-353(1973).

The high M_1 sterility is a factor limiting increased mutation frequency after treatment with nitrosoamides, such as N-methyl-N'-nitro-N-nitrosoguanidine, N-methyl-N-nitrosourea, N-methyl-N-nitrosourethane, and N-ethyl-N-nitrosourethane, whereas for ethylvinylnitrosoamine treatment the limiting factor is the toxic action on the M_1 seed germination. A decreased mutation frequency at high dimethylnitrosoamine doses is explained by the inhibition of enzymes or enzyme-like systems that hydroxylate nitrosoamines in vivo and thus enable the production of a mutagenic alkylating intermediate. An increased mutation frequency after treatment with x rays is limited both by the decreased M_1 survival and the M_1 fertility. (Nuclear Sci. Abstr. Czech.)

24231 EXPERIMENTAL METHODS OF RADIOMUTAGENESIS IN COTTON PLANTS AND RESULTS OF TESTING PROMISING MUTANTS. Gulamov, M. K.; Narimov, S.; Atazhanov, M.; Rykhsikhodzhaev, T.; Azizov, B.; Azimova, A. p 31 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian).

In order to induce radiomutations in cotton plants under the effects of γ irradiation the commercial varieties 108-F, S-4727, S-3606, 153-F, and others were irradiated. The irradiation was done with ^{60}Co γ radiation in the dose interval from 0.1 to 100 kR. The radiobiological effect in the year of irradiation and after the first vegetation period was determined. The radiobiological effect for cotton plants increased with increase of dose, dose rate, and duration of irradiation and also depended on the thermal treatment of the seeds. More than fifty radiomutations were obtained. With respect to quantity the following radiomutagenic forms of cotton had the most advantageous characteristics: RS-1, RS-3, RS-13, RS-16, RS-25, and RS-28. (tr-auth)

24232 CYTOLOGICAL STUDIES IN NORMAL AND MUTAGEN TREATED STRAINS OF TRITICALE (TRITICALE HEXAPLOIDE). Srivastava, H. K.; Malik, K. P. (Meerut Univ., India). Curr. Sci. (India); 43: No. 15, 470-473(5 Aug 1974).

Three strains of wheat were treated with gamma radiation and a combination of EMS and gamma radiation. Tables are presented to show chromosome analysis following treatment with various doses of radiation and EMS. Pollen viability, kernel weight, and number of kernels per spike were also studied. (HLW)

24233 CYTOTOXICITY AND MUTAGENICITY OF IRRADIATED FOODS. Moutschen, J. (Liege Univ. (Belgium). Dept. de Genetique). Food Irradiat. Inform.; No. 2, 51-64(Sep 1973). (In French).

34 refs.

The question of whether consumption of irradiated food may be harmful to man is one that has concerned researchers ever since irradiation as a means of food preservation was recognized as feasible. Potential hazards exist in various forms, for example, losses in nutritive value or the appearance of chronic toxic effects, which may vary in their ease of detection; possible mutagenic and cytotoxic effects of irradiated foods are among those which may be more difficult to detect. A comprehensive account is presented of recent work on cytotoxicity and mutagenicity testing of irradiated foods. Tests that are at present used for identification of these effects have been grouped into three categories: tests designed to detect biochemical mutants in microorganisms either in vitro or in vivo, tests based on electron microscopic evidence of cellular and chromosomal lesions, and tests aimed at revealing effects upon the whole cell of an organism. The results of recent mutagenic and cytotoxic tests on irradiated foods, including fruits and fruit juices, potatoes, milk powder, and flour are surveyed. Furthermore, the limitations of the various testing methods are emphasized, not least of importance being the difficulty of extrapolation to man; the qualities which a good test should possess are discussed. (auth)

24234 EFFECT OF DIFFERENT DOSES OF X RAYS (10,000 AND 20,000 r) ON THE COMPOSITION OF FATTY SUBSTANCES OF THE SUNFLOWER FRUIT DURING THE DEVELOPMENT AND RIPENING. Cupic, Z.; Miric, M.; Damanski, A. Hrana Ishrana; 13: No. 3-4, 115-119(1972). (In Serbo-Croatian).

The content of unsaponifiable matter and tocopherol in oil decreased during the development and ripening of fruits in all the examined groups of sunflower. The content of saturated acids decreased, the content of oleic acid in the first phases of seed development was markedly high, then it decreased, while the content of linoleic acid was steadily on the increase. (Bull. Sci. Sect. A)

24235 INDOLYL-ACETIC ACID CYTOGENETIC EFFECT ON IRRADIATED MAIZE SEED. Baibekova, T. K.; Seisebaev, A. T. (Inst. of Experimental Biology, Alma Ata, USSR). Tsitol. Genet.; 8: No. 2, 163-165(1974). (In Russian).

The indolyl-acetic acid (IAA) effect on the frequency of chromosome damages induced by radiation is considered. Steeping and germination of γ-irradiated seeds (5, 15, 25 kR) for 48 hrs in 1.25×10^{-4} M indolylacetic acid solution promotes a decrease in chromosome aberration frequency only 96 hrs after seed germination starting. A modifying effect of IAA is supposed to be connected mainly with regenerative type of recovery. (auth)

24236 PROMISING MUTANTS IN SOYA. Dzhosan, N.; Nikolae, I. (Agricultural Inst., Bucharest). Genetika; 10: No. 6, 43-50(Jun 1974). (In Russian).

A wide diversity of mutations valuable for breeding purposes can be induced, particularly, by thermal neutrons and gamma rays at a 30 kr dose and also by repeated irradiation of the progeny of irradiated plants. Mutants were obtained characterized by a conspicuous precocity, those with a higher seed productivity, with a greater vegetative mass and with certain features determining a better adaptibility to environmental conditions. Specific morphophysiological features of certain mutants afford a possibility of more economic methods of cultivation and harvesting with the use of modern machinery. Some of these mutants are already undergoing preliminary tests as possible future new cultivars. (auth)

Radiation Effects on Animals

Refer also to abstracts 23979, 24155, and 24366.

24237 (AECL-4833) BIOLOGY AND HEALTH PHYSICS DIVISION PROGRESS REPORT, JANUARY 1 TO MARCH 31, 1974. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). May 1974. 56p. Dep. NTIS (US Sales Only) $6.00. AECL $1.50.

Research progress is reported in the areas of biology, population research, environmental research, and health physics. Lists of publications giving research results are included. (MCG)

24238 (KURRI-TR-105) PROCEEDINGS OF THE STUDY MEETING ON INITIAL STAGE IN THE BIOLOGICAL EFFECT OF RADIATION AND THE CHAIN REPARATION MECHANISM, KUMATORI, OSAKA, JAPAN, 10 JANUARY 1972. Hatano, H.; Saito, M. (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). (Research Reactor Inst.). 1972. 30p. (In Japanese). NTIS (US Sales Only).

Separate abstracts were prepared for each of the 7 papers. (MCG)

For abstracts of individual papers see: 23643-23645, 24153-24155, and 24197.

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Refer also to abstracts 23975, 24372, 24473, 24829, 25722, 25723, 25949, 26102, 26113, 26114, and 26116.

24239 (AED-CONF-73-546-014) REGULATIONS CONCERNING THE RADIATION DOSE TO OCCUPATIONALLY EXPOSED PERSONS AND PERSONNEL MONITORING. Kossel, F. (Bundesgesundheitsamt, Neuherberg/Muenchen (F.R. Germany). Abt. fuer Strahlenhygiene). 1973. 15p. (In German). INIS.

From 14th annual meeting of the Vereinigung Deutscher Strahlenschutzaerzte; Wuerzburg, Germany (16 Nov 1973).

The need for the recording of the personal doses of those staff members who are normally working in controlled areas, or of those persons who enter controlled areas only occasionally, without being directly engaged in the actual application of x-rays is discussed. The controlled area as such exists only as long as the particular x-ray device is switched on. Thus persons working in an x-ray room only when the x-ray tube is out of operation must not be included in the personnel monitoring scheme. It is recommended that the relevant provisions of the x-ray Ordinance not be interpreted too restrictively, as it may often be useful to have more persons than actually needed regularly monitored within the framework of the personnel dosimetry system in order to be able to replace a staff member by another in case of illness or leave of absence. Moreover, the use of dosimeters allows the measurement and recording of personal doses in dependence of a person's position and the distance from the x-ray device during the application of x-rays. This is important as the local dose from x-ray devices may vary by a factor one to ten as a result of a change in position of the person handling the x-ray device. According to the author, there is a gap in the Ordinance as it explicitly enumerates only the persons who are allowed to work in controlled areas but does not mention any other persons who may work in these areas only occasionally and should then, of course, also be included in the personnel monitoring system. (INIS)

24240 (AED-CONF-74-140-003) INDICATION AND RADIATION HAZARDS IN OBSTETRIC X-RAY EXAMINATIONS. Brezina, K. (Vienna Univ., (Austria). 1. Frauenklinik). 1974. 6p. (In German). INIS.

From German x-ray congress; Baden-Baden, F. R. Germany (25 Apr 1974).

In the first ten years of children's lives, leukemias, malignoms, and malformations seem to occur more frequently where their mothers were exposed to x rays during pregnancy. Therefore, the obstetric x-ray diagnosis should be replaced wherever it is possible by radioisotope application and ultrasonic methods. (GE)

24241 (AED-CONF-74-221-002) CONTROL OF THE BLOOD COUNT AND OF THE HEMATOPOIETIC TISSUES. Schreml, W. (Ulm Univ. (F. R. Germany). Abt. Klinische Physiologie). 1974. 10p. (In German). INIS. (CONF-740662-2).

From 15th annual meeting of the Vereinigung Deutscher Strahlenaerzte e.V. on the authorized physician within the meaning of the Radiation Protection Laws; Karlsruhe, F. R. Germany (14 Jun 1974).

2 figs.; 10 refs.

The selectivity of the presently available hematological routine technique for recognition of a radiation exposure that is within a dose range that may be used for the detection of a radiation damage is discussed. In man, significant changes of the peripheral blood are not expected to occur until a radiation dose of more than 100 rads and only at a definite time post-irradiation. According to the radiation protection ordinance a person who is supposed to have received a single dose of more than 25 rem must be introduced to the authorized physician. The results of the hematological examination were not satisfactory in the case just mentioned but if the limiting value is exceeded to a greater extent the investigation would be sufficient to prove the radiation exposure. The mode of exposure expected more often is a continuous irradiation with small doses. In this case routine monitoring of the peripheral blood might detect radiation-induced disturbances only if the dose of 3 rem defined in the radiation protection ordinance as upper limit for 13 subsequent weeks would be exceeded by several scales. This limiting statement raises the question of what better techniques might exist or perhaps could be developed. The search for a screening procedure, which would detect disturbances in an early stage, must start from a pathophysiological point of view about the hemopoietic system. Some quantitative assays for the single stem cell storage space which were quarried in mice during the last years are briefly represented and their possible application is discussed. It will be a long road from the stage of experimental basic research to the application in radiation protection. (GE)

24242 (BARC/I-259) SAFETY ASPECTS IN PLUTONIUM HANDLING. Janardhanan, S.; Krishnamurthy, T. N.; Dabhakar, S. B.; Soman, S. D. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 80p. INIS.

Important safety aspects in handling plutonium, including criticality considerations, are reported. Safe handling problems are broadly divided into six groups viz. radiological safety; engineering safety; contamination evaluation, control, and prevention; decontamination; plutonium fire hazards; and control and criticality safety. Each of these is discussed in detail. (INIS)

24243 (BARC/I-263) SUMMARY OF PERSONNEL RADIATION EXPOSURES IN BARC FOR THE YEAR 1972. Watamwar, S. B.; Unnikrishnan, M.; Mogal, M. P. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 24p. INIS.

A summary of personnel radiation exposures of Bhabha Atomic Research Centre during the year 1972 is presented. There were only three cases of annual cumulative whole-body doses exceeding 5 rem, the highest annual cumulative dose being 6.03 rem. It was also observed from fortnightly significant overexposure cases, that twenty whole-body exposure cases with doses exceeding 1 rem, twenty-three skin exposure cases with doses exceeding 3 rem and 4 extremities exposure cases with doses exceeding 6 rem were reported. Whole-body counting results showed that no radiation worker in BARC exceeded a maximum permissible body-burden for any detected isotope for which he was counted. The highest reading of body-burden recorded during this period was 729 nCi for ^{137}Cs (i.e. 0.0243 of MPBB). There was not a single internal exposure exceeding one tolerance for any detected isotope. The highest internal dose recorded for detected isotope (^{131}I) was 0.48 tolerance due to acute exposure. (auth)

24244 (CCEN-29) STATISTICS OF RADIATION DOSES FOR PERSONNEL WORKING IN NUCLEAR MEDICINE AT RECIFE, BRAZIL. Barreira Filho, J. L.; Hazin, C. A.; Ribeiro, F. A. (Universidade Federal de Pernambuco, Recife (Brazil). Centro de Energia Nuclear). Apr 1972. 14p. INIS.

The analysis of personnel monitoring is made by comparing the results among four distinct groups of persons working in Nuclear Medicine at Recife, during the year of 1971: radiotherapists and technicians working in Curietherapy, radiotherapists and technicians operating only with external irradiators (teletherapy), radiologists and their technicians, and last the specialized personnel working in isotopetherapy. Another analysis is made inside each group, by dividing the personnel into their respective functional categories (physicians and technicians) and calculating the monthly average dose per man in each subgroup and in the whole group of monitored personnel. Some considerations are made about the global results from the point of view of radioprotection, by classifying the groups and determining the cases where the maximum permissible doses were exceeded. (INIS)

24245 (CCEN-30) ASPECTS OF RADIATION DOSIMETRY AND RADIOLOGICAL PROTECTION IN CANCER HOSPITALS OF THE NORTHEAST BRAZIL. Durham, M. E. (Universidade Federal de Pernambuco, Recife (Brazil). Centro de Energia Nuclear). Jun 1972. 22p. INIS.

Twelve of the 19 cancer hospitals in Northeast Brazil are controlled by the Comissão Nacion de Energia Nuclear; dosimetric procedures are carried out in deep x-ray therapy units and in telecobalt and telecesium units. Radiometric surveys were made with detailed maps. Doors and walls were protected with lead and concrete. Radium installations were also surveyed and mapped. Dosimeters are being used in 50% of the centers. The need for a training center for clinical radiologists is emphasized. (INIS)

24246 (COO-3268-7) SEVENTEENTH YEAR PROGRESS REPORT, JULY 1, 1973–JUNE 30, 1974. (Jefferson Medical Coll., Philadelphia, Pa. (USA). Stein Research Center). 1974. Contract AT(11-1)-3268. 22p. Dep. NTIS $4.25.

Progress is reported on studies on the effects of external x irradiation and internal irradiation following intravenous injection of ^{211}At into the mother of rat fetuses. Results are reported from studies on the effects of embryonic irradiation at various doses and dose rates on adult life expectancy, the development of leukemia, and the incidence of congenital malformations. (CH)

24247 (CS-1329) PROJECT COUNCIL: INFORMATION MEETING (HEALTH), FEBRUARY 1, 1944. Compton, A. H. (Chicago Univ., Ill. (USA)). 8 Feb 1944. 5p. Dep. NTIS $4.00.

Hazards of plutonium, urine sulfur excretion following injection of uranyl initrate, rabbits survival following single x-ray exposures, gaseous radioactive effluents, and protection of personnel are briefly discussed. (MCG)

24248 (NRPB-R-20) RISK OF DEATH FROM RADIATION-INDUCED CANCER AS ESTIMATED FROM THE PUBLISHED DATA ON THE JAPANESE ATOMIC BOMB SURVIVORS. Goss, S. G. (National Radiological Protection Board, Harwell (UK)). Apr 1974. 36p.

The latest published data on the Japanese atomic bomb survivors are reviewed and the difficulties in using them to derive a reliable risk estimate for radiation-induced cancer are discussed. The age distribution of the survivors is shown to be abnormal and ranges of risk are estimated for a standard age distribution. The time trend of mortality shows that the large majority of radiation-induced leukemias have occurred already but the same cannot yet be said for other types of cancer. While radiation risks expressed as ranges of values are less misleading, for simplicity in practical radiological protection single risk values are needed. The values suggested here are 30 per million persons per rad for leukemia and 100 per million persons per rad for all types of cancer. (auth)

24249 (PB-229705/9) POPULATION DOSE FROM X-RAYS, U. S. 1964. Estimates of Gonad and Genetically Significant Dose from the Public Health Service X-Ray Exposure Study. (Bureau of Radiological Health, Rockville, Md. (USA)). Oct 1969. 138p. (PHS-PUBL.-2001). NTIS $10.00.

The report is based on one of a series of studies conducted by the United States Public Health Service to estimate population exposure from x rays. Interest in this problem was manifested as early as 1952, and intensified in 1956, when studies were published in several countries suggesting that the levels of man-made genetically significant radiation were rather substantial. The recent passage of the Radiation Health and Safety Act of 1968 (Public Law 90-602) reflects the growing concern of responsible persons and agencies for the need for research on the effects of radiation exposure to persons and the control of radiation hazards. The x-ray exposure study of 1964 provides data on the exposure and dose resulting from medical diagnostic x-ray procedures and provides an essential baseline for evaluating the effectiveness of program efforts in the control of excess radiation exposure from these procedures. (GRA)

24250 (RL-74-038, pp VII.1-VII.16) INFLUENCE OF RADIATION QUALITY UPON ITS BIOLOGICAL EFFECTS.

Berry, R. J. (Churchill Hospital Research Inst., Oxford). Mar 1974.

The biological effects of ionizing radiations are reviewed with emphasis on the following topics: effects of X and gamma radiation on body tissues and cell reproductive capacity; effects of alpha particles and fast neutrons on mammalian cells with regard to RBE, OER, and LET; fast neutrons and clinical radiotherapy; and effects of negative pi-mesons on biological systems and their use in radiotherapy. (HLW)

24251 (UCID-15556) HAZARDS CONTROL DEPARTMENT SIMULATED EMERGENCY EXERCISES, 1952 to 1969. Dutra, J. A.; Purington, R. G.; Bennett, W. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). [nd]. 36p. Dep. NTIS $5.00.

Factors contributing to the establishment of the LRL-Livermore Hazards Control Department on March 20, 1959, are discussed. Simulated exercises are described under the following headings: first interdisciplinary exercises; an exercise with minimum preplanning; an exercise with medical department participation; a transportation accident involving fissile material and injuries; coordinated response exercises; revision of the 1967 disaster control plan; a test of the new disaster control plan; and an exercise involving LRL activation off-site. (HLW)

24252 THE SIGNIFICANCE OF TECHNICAL RISKS. Lindackers, K. H. (Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (F. R. Germany)). Atomwirtsch., Atomtech.; 19: No. 6, 284-288(Jan 1974). (In German).

From reactor meeting 1974; Berlin, F. R. Germany (2 Apr 1974). 6 tabs.; 26 refs. with abstract.

In discussions on the peaceful use of nuclear energy, opponents and supporters apply the notion "risk" with different meanings. In order to avoid misunderstandings, in this connection the notion "damage risk" should be used. Damage risk means that disadvantages may but must not necessarily appear. In order to obtain a survey of the various damage risks, it is necessary to set up damage risks-groups, divided into damage objectives, kind of damage, origin of damage, and risks groups. The quantitative statements here are limited to the groups: damage objective "persons" and kind of damage "death". On the basis of accident statistics, damage risk values for deadly accidents at work can be determined for the different industrial branches. A comparability of the damage risk is obtained, dividing the number of insured persons and number of working hours per person and year by the number of deaths. (auth)

24253 SOME HISTORICAL ASPECTS OF WHOLE-BODY IRRADIATION. Ratkoczy, N. (Semmelweis Orvostudomanyi Egyetem, Budapest (Hungary). Radiologiai Klinika). Strahlentherapie; 147: No. 1, 45-46(Jan 1974). (In German).

The first application of whole-body irradiation in 3 patients with leukemia, performed by a Hungarian radiologist in 1905, is described on the basis of the literature. (auth)

24254 FORMALIZATION FOR QUANTITY AND DISTRIBUTION OF RADIOISOTOPES IN HUMAN BODY. Fundamental Investigation on Internal Absorbed Dose. Nishizawa, K. (Nagoya Univ., Japan). Kaku Igaku; 10: No. 4, 381-387(Aug 1973). (In Japanese).

A method of quantitative evaluation of approximate three dimensional distributions for the calculation of internal absorbed dose according to the dose reciprocity theorem is described. For measurements, the linear scan method was adopted using a NaI-(Tl) detector with a non-focal rectangular slit collimator attached. For the distribution along the body axis, with the results of scanning a radioisotope radiation source, P (x), with detectors D_1 and D_2 as P and Y, an arbitrary time, t, was transformed with a variable, T = -vt to obtain a formula $Y(T) = \sum_{n=1} CnPn(T)$. A method for connecting the distribution along the body axis with that in the section was investigated. The relation to the Mird method, the method of measurement and data processing, the distribution along the L axis, a hypothetically concentrated point, the permissible approximation area, the measuring method of constant count rate, the method of quantitative analysis, the possibility of application to other problems such as nuclides emitting both β and γ rays, and the examination of theory by experiments and computation are discussed. (JA)

24255 SEX RATIO SHIFTS AMONG PROGENY FROM PATIENTS HAVING RECEIVED THERAPEUTIC X-IRRADIATION. Scholte, P. J. L. Amsterdam; Vrije Universiteit (1974). 100p. (In Dutch).

Thesis.

Literature on sex ratio shifts in progeny of irradiated males and females is reviewed. Data obtained from Dutch hospitals show a decrease of the sex ratio of progeny after maternal irradiation. Combined with data from France, this decrease is significant. Following paternal irradiation a significant increase in sex ratio was found in the progeny. After paternal exposure to low doses (1 to 7.5 rads) no change was observed in the sex ratio. (NL)

24256 ON THE INFLUENCE OF ANTICOAGULATING AGENTS UPON THE RADIOREACTION OF THE SKIN. Drescher, J. Giessen, Ger.; Giessen Univ. (1972). 62p. (In German). INIS.

With figs. and tabs.; 58 refs. With abstract. Available from the library of the Giessen Univ.

The general and skin reaction of 36 female patients during and after post-operative irradiation for the treatment of mammary carcinomas is reported. Sixteen patients were given the anticoagulating agent Marcumar as a precautionary measure. Following the collection of anamnestic and clinical data, the course of the radioreaction was evaluated on the basis of the usual dermatological criteria. Results of the hitherto most frequently applied measurements of erythema were compared with semiquantitative thermal measurements of the irradiated skin surface, which allows early detection of pathological blood distribution in irradiated skin areas. General symptoms in terms of the so-called general radiation syndrome were less frequently observed in patients treated with Marcumar, which likewise reduced the clinically observed skin reaction in these patients. Three hyperthermal phases could be identified, with the mean temperature maxima occurring most frequently in the first, at the end of the second, and in the fifth week. The strongest deviation in temperature from the average of 2°C was observed during the third hyperthermal phase, which frequently is followed by further temperature fluctuations. Sufficient inhibition of coagulation, studied in a twin experiment on a patient with bilateral mammary carcinoma, caused the entire thermal reaction process to set in earlier than in other patients and led to a flattening of the amplitude. A comparison of the results obtained by differential measurements of the skin temperature of irradiated and non-irradiated skin areas of the front thorax quadrant of patients treated with anticoagulants and of the control group showed a highly significant temperature deviation in the fourth week of irradiation. Systematic coagulation analyses prior to, during and after the radiation treatment revealed an enhanced coagulation tendency of the blood in more than half of the patients examined, predominantly in patients with advanced stage carcinoma. (GE)

24257 ELECTRON THERAPY OF INTRATHORACAL TUMORS. Kuttig, H.; Oeftering, T.; Schnabel, K. (Heidelberg Univ. (F. R. Germany). Strahlenklinik). Electromedica; No. 3, 100(1973). (In German).

12 figs.; 10 refs.

Procedures for optimization of the irradiation planning for moving-field irradiation are discussed. Dose distributions at the Alderson phantom using a 42-MeV betatron were determined by film densitometry under ionometric control. The results show a minimum damage to the lung tissue for energies between 25 and 30 MeV and a field width of 4 cm. Clinical results are given for 30 patients irradiated with a focus dose of 5 × 200 rads up to a total dose of 6,500 to 7,000 rads/week. No side-reactions of the skin, mucous membranes, and lung tissue were observed. (HP)

24258 HISTOCHEMISCHE BEFUNDE IM ZAHN UND IHRE BEEINFLUSSUNG DURCH ROENTGENSTRAHLER. (Histochemical Findings in Teeth and the Possible Effects of X Rays). Rottke, B. Muenchen, F. R. Germany; Hanser (1972). 64p. (ISBN-344610243).

32 figs.; 2 tabs. With refs. Also publ. as Habil. Schr.

Experiments were carried out on the molar teeth of young rats using histochemical reactions in order to determine alkaline and acid phosphatase, proteins, carbohydrates, and fats. Non-irradiated animals served as controls. X rays induce different disturbances in the metabolism of the dental pulp. The acid phosphatase, mainly located in the odontoblasts, is scarcely affected, whereas the alkaline phosphatase, located in the subodontoblasts, decreases significantly. The amount of carbohydrates (PAS—positive substances and acid mucopolysaccharides) increased initially in the entire dental pulp after exposure to x rays but decreased again after a certain time. The same applied to the protein content of the pulp. As to the nucleoproteins, the content of DNA rose to the detriment of RNA. Furthermore, a diminished stainability of the cell membranes of the odontoblasts was observed. Relatively low radiation doses will cause disturbances in the metabolism of the dental pulp, affecting the cell functions without observable morphological changes. These findings are in agreement with the results of radiobiological research work. It can be concluded, therefore, that the observed radiation damage to the teeth is a result of a primary effect on the metabo-

lism of the dental pulp and of a secondary radiation effect via the salivary glands. (GE)

24259 DIE STRAHLENBELASTUNG VON PATIENTEN BEI DER NUKLEARMEDIZINISCHEN ANWENDUNG OFFENER RADIOAKTIVER STOFFE. (The Radiation Dose to Patients During the Application of Unsealed Radioactive Substances in Nuclear Medicine. 2. Revised and Enlarged Ed.). Kaul, A.; Oeff, K.; Roedler, H. D.; Vogelsang, T. Informationsdienst fuer Nuklearmedizin. Berlin, F. R. Germany; Klinikum Steglitz (1973). 704p.

With refs.

This comprehensive study reviews more than one thousand publications from the recent scientific literature dealing with the application of unsealed radioactive substances (radiopharmaceuticals) for diagnostic or therapeutic purposes in nuclear medicine. Dose values for the various organs are shown in tables and methods and special conditions of examination as well as the activities applied are given. It is also indicated whether the particular publication referred to contains any information about the biokinetic data on which the given dose values are based. Only those publications have been included in this compilation which either give dosimetric data or which are of interest with regard to the dosimetry of incorporated radioactive substances. The dose values given are based on a reference value of 1 μCi in order to facilitate comparison of the dose values given by the various authors. (GE)

24260 INFLUENCE OF BUILDING MATERIALS ON THE RADIATION DOSE TO THE POPULATION. Kolb, W. Atom-Inform.; No. 4, 18-20(1974). (In German).

First data on the local dose rate in free air and in houses from the terrestrial component of the background radiation essentially due to ^{40}K, ^{226}Ra, ^{232}Th, and daughter products are given for different regions of the Federal Republic of Germany. (GE).

24261 EFFECT OF TELEKOBALT-IRRADIATION OF THE CHEST ON PULMONARY FUNCTION. Witek, F.; Garbsch, H.; Schnetz, E. (Wilhelminenspital, Vienna (Austria). 2. Medizinische Abt.; Wilhelminenspital, Vienna (Austria). Roentgeninstitut). Pneumol./Pneumol.; 149: No. 4, 287-296(1973). (In German).

With figs.; 2 tabs.; 20 refs.

The effect of telecobalt irradiation of the thorax on pulmonary function was examined. No change of pulmonary function was observed in any of patients in whom preventive irradiation of the thorax wall was performed after resection of a mammacarcinoma. In successful irradiation of a bronchus carcinoma, improvement of pulmonary function resulting from removal of respiratory distribution disturbance is observed. Blood gases become normal and airways resistance improves. In two thirds of cases reduced pulmonary volumes result from fibrous changes of sections of the lung afflicted by the tumor even when irradiation is successful. Deterioration of all pulmonary function tests during irradiation is an indication of continuing growth of the carcinoma. A complication of irradiation is physical irritation of healthy lung tissue, acute radiation pneumonitis. This is followed by marked deterioration of pulmonary function. These changes are reversibly appropriate by therapy started in good time but there is often limited interstitial fibrosis, leading to reduction of ventilatory tissue. The respiratory capacity persisting depends on the functional status of the remaining lung. (auth)

24262 NATIONAL ENVIRONMENTAL HAZARDS AND INTERNATIONAL LAW. Dickstein, H. L. (Malaya Univ., Kuala Lumpur, Malaysia). Int. Comp. Law Quart.; 23: 426-446(Apr 1974).

A solution is sought to the problem of national environmental hazards and it is considered that one such is the establishment of international environmental standards, promising at least minimum controls everywhere as well as promoting global economic efficiency and preventing the formation of national environmental barriers to free trade. It is the purpose of this analysis to elucidate the role international law can, and is, playing in implementing this goal and the barriers it faces. The method of analysis involves the use of a radioactive pollution model. The analysis has two subsections: the first one sets out the factual parameters of the subject in the conviction that law making in this area must be directly responsive to the verified risks, while the second one assesses the role of international law in dealing with those risks. It is concluded that although the domestic jurisdiction barrier has not kept international pressure from being brought to bear on radioactive contamination problems, its effect has been to emasculate the methods of exercising that pressure. Only in the case of the European Communities does the potential for effective and exacting controls exist. There is little evidence that supranational arrangements of this nature will be adopted in other regions in the foreseeable future and less evidence that they will be adopted on a universal basis. Recent practice indicates that international law now plays an indirect role in national radiation control. (UK)

24263 IRRADIATION IN THE REGION OF THE EYE. Brands, T.; Froessler, H. (Muenster Univ. (F.R. Germany). Radiologische Klinik). Klin. Monatsbl. Augenheilk.; 164: No. 3, 340-345(Mar 1974). (In German).

6 figs.; 3 refs.

The possibilities of radiation in the ocular region in benign and malignant tumors are considered. Examinations carried out on anatomical models and on patients with the aid of the thermoluminescence dosimetry have encouraged widening the range of indication for radiation in the ocular region. The eye itself could be shielded by appropriate protective measures such as with lead contact lenses and lead cylinders. Various indications for radiation therapy are given. (auth)

24264 RATIONALIZING THE CALCULATION OF DOSE DISTRIBUTION IN TELECURIETHERAPY. Matula, P.; Futas, E.; Kundstadt, E.; Klvana, M. (Safarik Univ., Kosice, Czech.). Cesk. Radiol.; 27: No. 3, 207-214(May 1973). (In Slovak).

A method is described of simplifying computer programs in the preparation of radiotherapy plans, in the calculation of the exposure time, the surface dose, and other parameters in telecurietherapy. The method is based on the reduction of input data from 60 to 80 down to 2 by the approximation of the patient's silhouette to an ellipse. A more detailed description is presented of the calculation of the exposure time, the surface and the total doses, the integral dose and the efficient integral factor. The calculations were made using the per cent dose at a constant source-skin distance. (Nuclear Sci. Abstr. Czech.)

24265 ACTION OF IONIZING RADIATION AND ULTRASONICS ON THE PRODUCT OF CONCEPTION. Szijarto, A. (Univ., Padua). Minerva Ginecol.; 25: 536-538(Sep 1973). (In Italian).

Studies on the effects of low-level radiation, particularly from radioisotopes used diagnostically in cases of obstetric pathology, are reviewed briefly. It is concluded that therapeutic use of radiation and ultrasonics should be avoided during pregnancy. (JSR)

24266 RADIOSCOPY AND THERAPY WITH PROTON BEAMS. Gerwin, R. MPG (Max-Planck-Ges.) Presseinform.; No. 3, 1-4 (1973). (In German).

The therapy and diagnosis with x rays may be replaced in the future by proton beams. The advantage of these beams is not only the clear visualization of muscles and fatty tissues but also a decrease of damage to the healthy tissue during radiotherapy. Therefore, the applicability of proton beams in medicine and physics is being investigated at the present in the Max Planck Institute for Nuclear Physics and in the German Cancer Research Centre, Heidelberg. (GE)

24267 FUNCTIONAL CONDITION OF THE LIVER IN RADIATION AND DRUG THERAPY OF MALIGNANT TUMORS OF BONES. D'yakova, A. M.; Stefani, N. V.; Bizer, V. A. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 19: No. 7, 45-50(Jul 1974). (In Russian).

Using biochemical tests the functional condition of the liver after radiation and drug therapy of malignant tumors of bones was studied. Inhibition of some functional hepatic tests was observed only in relapses and metastatic spreading of osteogenic and Young's sarcomas. With clinically favorable course, biochemical indices were stable during the entire observation. (auth)

24268 COMPLEX TREATMENT WITH RADIATION ACTION ON THE HYPOPHYSIS IN GENERALIZED CANCER OF MAMMARY GLAND. Izmailova, G. E.; Svyatukhina, O. V.; Starichkov, M. S. (Inst. of Experimental and Clinical Oncology, Moscow). Med. Radiol.; 19: No. 7, 3-8(Jul 1974). (In Russian).

Results are presented of complex treatment with radiation action on the hypophysis (pituitary) administered in 69 patients suffering from mammary gland cancer at the stage of generalized metastatic spreading. Radiation action on the hypophysis was one of the components of a complex treatment. The main point in the treatment was a long-term hormonotherapy, which practically lasted the whole life after the operation. Irradiation of the hypophysis was carried out using telegamma-therapy. The hypophysis was irradiated from 2 opposite temporal areas, 30 × 30 mm, a one-time focal dose was 200 rad, cumulative focal dose in the majority of the patients reached 5000–6000 rad and was realized within 5–6 weeks. As a result of the complex treatment an objective effect with an average life span of 15 months was obtained in 16 patients. Subjective improvement was obtained in 19 patients, average period of clinical improvement was 6.2 months. In half of the patients, the treatment was ineffective. The relation between the life span of the patients and the efficacy of complex

treatment was established. Survival of patients in objective regression of metastatic spreading was three times higher than in ineffective treatment. Complex therapy was more effective in metastatic spreading in the bone in comparison with visceral metastasization. Data on morphological changes in the hypophysis under the influence of the treatment were given. The results of histological investigation of the hypophysis were compared with the change of hormonal balance of the body. (auth)

24269 RADIATION OSTEOMYELITIS OF THE LOWER JAW AFTER RADIATION THERAPY. Garbuzov, M. I. (Moscow Medical Inst. of Stomatology). Med. Radiol.; 19: No. 7, 13-17(Jul 1974). (In Russian).

On the basis of analysis of the clinico-roentgenological picture radiation osteomyelitis of the lower jaw in 17 patients after radiation therapy in connection with cancer of various localities in the oral cavity, three variants of this complication were analyzed. Radiation osteomyelitis of the lower jaw, as a rule, was accompanied by acute inflammatory symptoms with the formation of fistulae, suppuration, and sequestration. With the affection of the anterior portion of the lower jaw body rapid spontaneous rejection of the sequestrum was observed, while with similar affection of its posterior portions there developed marked trismus preventing it. After completion of demarcation clearly seen roentgenologically surgical excision of the sequestrum promoted complete recovery of the patient, naturally, with the absence of relapses and metastases. Even with the presence of the mentioned phenomenon removal of the sequestrum brings about considerable alleviation of the symptoms. A case of a rare atypical "central" variant of radiation osteomyelitis of the lower jaw, which is possible only with the presence of healthy teeth which prevent penetration of infection and preservation of the alveolar edge, is described. (auth)

24270 CANCER OF THE SKIN CAUSED BY A RADIOACTIVE GOLD RING. Holubar, K.; Helm, F.; Klein, E. (State Univ. of New York, Buffalo). Hautarzt; 24: No. 11, 489-491(Nov 1973). (In German).

A case history is given of skin cancer of the ring finger of the hand from a gold ring worn for 30 yrs. The skin was red, thickened, tender, and scaly. The ring contained ^{226}Ra and the following radiations were detected: alpha emission, 100%; 4.78 MeV and gamma radiation 4%; 0.168 MeV, 0.07%; 0.26 MeV, 0.42 MeV, and 0.61 MeV. A histological description is given and the symptoms and etiology of skin changes are discussed. (HLW)

24271 IONIZING RADIATIONS AND THEIR INFLUENCE ON SEX GLANDS, PREGNANCY, AND FETUS. Marinova, G. Akush. Ginekol.; 12: No. 3, 210-213(1973). (In Russian).

The influence of ionizing radiations on the female sex organs was studied in 223 women physicians, technicians and attendants working in x-ray rooms. The following menstrual disorders were recorded: oligomenorrhea in 19.7%, hypermenorrhea in 17.5%, dysmenorrhea in 16.1% and secondary amenorrhea in 4.4%. Of 15 women with menstrual disorders 5 had anovular cycles, 10 had decreased estrogen saturation, 9 had reduced pregnadiol values, and 10 had reduced 17-ketosteroid values. Of 438 pregnancies 12 terminated with premature delivery and 49 with spontaneous abortion. (Abstr. Bulg. Sci. Med. Lit.)

24272 OCHERKI RAZVITIYA OTECHESTVENNOY RADIATSIONNOY MEDITSINY. (Essays on the Development of Domestic Radiation Medicine). Vorob'ev, E. I.; Pobedinskii, M. N. Moscow; Meditsina (1972). 228p.

The history of the development of radiation medicine in Russia is reviewed. In order to give the reader a more complete idea of the development of medical radiology, sections are included on the history of the organization of radiation medicine, the training of radiology specialists, and the development of scientific research institutions. Special attention in the monograph is devoted to questions of the medical use of various sources of ionizing emission for radiation therapy, radioisotope diagnosis, and radon therapy. More sketchy information is given on the history of the development of radiation hygiene, occupational radiation pathology, and radiotoxicology. The monograph is illustrated with 33 photographs. The bibliography includes 103 sources of literature. (JPRS)

24273 MULTIPLE-CAUSE ANALYSIS OF DEATHS OF PATIENTS TREATED WITH RADIOIODINE. Donovan, J. W.; Adelstein, A. M. (Office of Population Censuses and Surveys, London). Brit. J. Prev. Soc. Med.; 28: 69(Feb 1974).

Since iodine-131 treatment was introduced for thyrotoxicosis the development of cancers among patients to whom it has been given has been monitored. Between 1949 and 1967 some 35,000 patients were notified to the National Cancer Registry as having received this treatment. Mortality in this group, 3,937 of whom died by the end of 1967, has been compared with that in England and Wales. The analyses were presented not only to show what happened to the patients but to demonstrate methodological aspects of multiple cause coding. Thyroid cancer mortality was greatly increased, but investigation of these cases showed that the majority were thyroid cancers registered in error or diagnostic errors; the true excess was small. Breast cancer mortality was also substantially increased, and as cervical cancer mortality was slightly in excess of expected it seems unlikely that this was due to an atypical distribution of reproductive histories. Mortality from lymphatic leukaemia was increased; this showed particularly in the multiple cause analyses. Four hundred and fifty three deaths were attributed to thyrotoxicosis which was also mentioned on a further 399 death certificates but not as the underlying cause. Mortality from ischaemic heart disease was approximately doubled, and deaths from embolism increased many times; many of the latter certificates mentioned atrial fibrillation. (auth)

24274 SMALL RISKS AND LARGE POPULATIONS: A SEVENTIES PHILOSOPHY FOR A SIXTIES PROBLEM. Walker, N. A. (Univ. of Sydney). Issue (Adelaide); 3: No. 9, 7-9(Jun 1973).

The effects of the French nuclear tests and possible attitudes to calculated risks are described. Approaches and attitudes to the fallout problem are suggested. (AT)

24275 ZASHCHITA NASELENIYA OT RADIOAKTIVNYKH OSADKOV. (Protecting the Population Against Radioactive Fallout). Sudakov, A. K. Moscow; Atomizdat (1973). 120p.

The causes of occurrence and nature of radioactive contamination and its effect on the human being are considered. There is a description of the dosimetric instruments with which civil defense formations are equipped. Individual and collective means of protection and measures to protect the population against radioactive substances are reviewed. Recommendations are given on adapting existing structures for radiation shelters and on the actions of people when threatened by radioactive contamination and when on contaminated terrain. The living conditions of population on contaminated terrain and steps to eliminate radioactive contamination are considered. (JPRS)

24276 BIOLOGICAL SIGNIFICANCE OF LOW LEVEL RADIATION DOSE. Ronai, P. M. Issue (Adelaide); 3: No. 9, 2-6(Jun 1973).

The biological and genetic effects of fallout from nuclear explosions are considered in relation to an upper limit risk factor. Biological radiation effects which are considered include leukemia, thyroid cancer, bone cancer, and gene mutations. It is suggested that the effects of low level radiation may have been greatly over-estimated. (AT)

24277 PRACTICAL RADIOPROTECTION MANUAL. Rodier, J.; Chassany, J. P. Paris; Maloine (1974). 360p. (In French).

Information necessary for a practical understanding of health physics is presented. The basic ideas behind radiation physics and the physics of radioactivity are discussed in the first three chapters. Chapter IV is devoted to the very important problem of establishing radioprotection norms, a problem rendered very difficult because of the quantitative uncertainties encountered in defining thresholds. After having enumerated these basic concepts, all the various different aspects of health physics are dealt with in detail. All the detectors and dosimeters in current use are studied. Both general aspects and specific aspects (applications to nuclear medicine, criticality accidents) of radioprotection principles are considered. The contamination of objects and the human body, the disposal of solid, liquid, and gaseous wastes, and the transport of radioactive materials are examined in detail. (FR)

24278 NECROPSY CASE OF RADIATION MYELOPATHY AND REVIEW OF THE REPORTED CASES. Satoyoshi, E.; Kinoshita, M.; Suzuki, Y.; Takazawa, Y. (Ohashi Hospital, Tokyo). Rinsho Shinkeigaku; 13: No. 10, 615-622(Oct 1973). (In Japanese).

A 24-year-old male developed radiation myelopathy about 2 years and 3 months after the completion of 28 days' radiation of Tele-^{60}Co for his reticulum cell sarcoma of the hypopharynx and the neck. The total radiation dosage was 12,000 roentgen units in 42 fractions and the estimated spinal cord dose was 8,066 roentgen units. The symptoms of radiation myelitis started with paresthesia of the right hand and fingers followed by weakness of the right arm and shoulder. The symptoms gradually progressed and the full feature of transverse myelitis below C_2 was completed 5 months later. He finally died of pneumonia and the necropsy revealed almost complete necrosis of C_7 segment with loss of myelin and axons of the posterior column and spinothalamic tracts above the level and of pyramidal tracts below the level. In C_7 segment, the grey matter was more severely affected than the white matter

with softening and formation of cysts. Review of the literature revealed about 300 cases of clinical reports of which nearly 80 cases had been necropsied. The incidence of the disease seems to be higher than expected. Considering the survival rate after the radiation for the original diseases, the incidence of cervical myelopathy probably exceeds 10%. The safety limit of the spinal cord dose is 2,000 rads. Cervical cord is more frequently affected than dorsal or lumbar cords, and cervical myelopathy shows the poorest prognosis. Those who show the onset of myelopathy earlier than 10 months after the completion of radiation have better prognosis than those whose neurological symptoms start later. (auth)

24279 RHEOGRAPHIC INDICES IN PATIENTS WITH CANCER OF THE LUNG DURING RADIATION THERAPY. Goncharova, I. M. (Scientific-Research Rentgen-Radiological Inst., Moscow). Med. Radiol.; 19: No. 8, 21-26(Aug 1974). (In Russian).

With the help of the rheography method the condition of hemodynamics of lesser circulation was studied in 42 patients with cancer of the lung who had undergone radiation therapy. Before treatment a considerable reduction of hyperemia of the lung and increase of pneumo-vascular resistance was found in the affected area of the lung. In the healthy lung the indices of rheograms were quite satisfactory. During radiation therapy with a cumulative focal dose of 3000 rad an increase of the rheographic indices was noted in patients with positive effect of treatment owing to the reduction of pressure on the vessels of the lung by the tumor and improvement of ventilation and gas exchange. However, by the end of treatment with cumulative focal dose of 5000 to 6000 rad in spite of objective effect, rheographic indices in these patients worsened due to a marked vascular reaction of the pulmonary tissue. In cases when the effect of treatment was not observed vascular reaction was revealed already with a dose of 3000 rad and had intensified by the end of the treatment. In the region of the healthy lung, in all the cases, blood circulation also worsened due to the reduction of the contractile capacity of the myocardium of the right ventricle of the heart. (auth)

24280 CONTRIBUTION TO PATHOLOGY AND TREATMENT OF POSTIRRADIATION ENTERITIS. Ciger, J.; Hildebrand, T.; Rychlo, A.; Bardos, L.; Cichy, A. (Safarik Univ., Kosice, Czech.). Vnitr. Lek.; 19: No. 8, 800-807(Aug 1973). (In Slovak).

Two cases are described of postirradiation enteritis accompanied with the malabsorption syndrome. Discussed are the symptomatology, diagnostics, treatment, pathology, and histology of the intestinal changes involved as well as the principles of internal and surgical treatment. A review is made of postirradiation enteritis incidence reported in literature. (Nuclear Sci. Abstr. Czeck.)

24281 PROTECTIVE EFFECT OF DNA-SPERMIDINE (DA-51) AGAINST RADIATION-INDUCED LEUKOPENIA. A Study on Breast Cancer Patients Receiving Prophylactic Irradiation. Tsuya, A. (Japanese Foundation for Cancer Research, Tokyo); Kaneta, K.; Okawa, T.; Wateri, T.; Asakura, H. Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 1, 26-32(Jan 1974). (In Japanese).

DNA-spermidine (DA-51), which was originally developed as a protective agent against radiation-induced leukopenia, was submitted to clinical trial by the double blind test. The radioprotective and side effects of DA-51 were compared to those of Inosine, selected as a control agent, on breast cancer cases receiving prophylactic irradiation. The same daily dose of 1800 mg of DA-51 and Inosine was administered orally during the period of irradiation of 1 to 3 weeks. The difference in white blood cell counts between DA-51 and Inosine treated groups was assessed at 1 and 3 weeks by Fisher's exact test. Significant differences in white blood cell counts assessed at 3 weeks were demonstrated between the DA-51 and control (Inosine) groups, with the probability of 0.021 and 0.036. Thus, the protective effect of DA-51 against radiation-induced leukopenia was proved. Regarding the side effect, one case of urticaria was encountered in the DA-51 group, and 2 cases of jaundice in the control (Inosine), but no causal relationship was demonstrated. Also no disturbance of the liver, gastrointestinal and kidney functions was encountered. (auth)

24282 METHODS FOR AMELIORATING THE RADIATION REACTIONS IN DEEP X-RAY (RADIATION) THERAPY. Mikhaylov, V. Rentgenol. Radiol.; 40: No. 4, 215-220(1972). (In Russian).

Radiation enteritis is a common reaction in deep x-ray treatment of tumors in the pelvic region. The high radiation sensitivity of the intestinal mucosa and the high doses that the bowel receives (50 to 100% of the focal dose which amounts to 4000 to 5000 rad) are primarily responsible for the early pathophysiologic and pathomorphologic lesions. Forty patients were irradiated by a method suggested by the author (Trendelenburg position at 30° incline toward the horizontal plane). Only 11 experienced mild gastro-intestinal disturbances with the use of a focal dose of 3500 to 4000 rad. In all other patients radiation treatment terminated uneventfully and without interruption. In a control group of 40 patients exposed with the body in a horizontal position gastro-1 intestinal disturbances appeared in 24 and with lower doses (2500 to 3500 rad). (Abstr. Bulg. Sci. Med. Lit.)

24283 METHOD FOR THE COMPUTERIZED ESTABLISHMENT OF TREATMENT PLANES IN INTERSTITIAL RADIOTHERAPY WITH ^{192}Ir WIRE. Volterrani, F.; Donati, G.; Rabbi, A. (Univ., Milan). Radiol. Med.; 60: No. 1, 42-52(Jan 1974). (In Italian).

A method for the computerized determination of treatment planes and dosimetry in interstitial therapy with ^{192}Ir wire is described and some examples of its application are presented. (auth)

24284 POSTOPERATIVE BRONCHOPLEURAL COMPLICATIONS IN COMBINED TREATMENT OF PULMONARY CANCER. Pirogov, A. I.; Maksimov, I. A.; Os'makov, N. A. (Research Oncological Inst., Moscow). Vop. Onkol.; 20: No. 6, 24-28(1974). (In Russian).

The incidence of bronchopleural complications in the combined treatment of pulmonary cancer, including preoperative gamma therapy, application of radioactive Au colloid solution associated with surgery, and administration of chemotherapeutic substances preoperatively, is analyzed. If an interval between the termination of a distant gamma therapy course and an operation was not adequate enough (less than 4 weeks), the number of bronchial fistulas increased. Some increase in the number of bronchial fistulas was also observed following preoperative thiophosphamide chemotherapy. The causes of incidence, clinical course and issues of bronchopleural complications in the combined and surgical methods of treatment show similar peculiarities. (auth)

24285 RECURRENCE OF ORAL CANCER IN PATIENTS WITH RADIO-OSTEOMYELITIS OF THE JAWS. Nwoku, A. L. (Univ. of Zurich). J. Maxillofac. Surg.; 1: 157-161(Sep 1973).

Twenty-six patients who developed radio-osteomyelitis after radiation therapy of various tumors of the oral cavity were studied. Special attention was paid to the dentition in the line of irradiation during treatment. In 22 cases, the highest dosage that caused radio-osteomyelitis was 11,415 rHD, and the lowest 4,064 rHD. The occurrence of radio-osteomyelitis did not necessarily indicate that cancer had been completely eliminated. Of the 26 patients under review, 19 of them were free of cancer, and in 7 cases (26.9%), there was a recurrence of tumor or new cancer or metastasis. The period of latence before cancer recurrence was evidenced varied from 3 months to 4 years. (auth)

24286 RTPFIT: A PROGRAM TO FIT THE EXTENDED GENERAL FIELD EQUATION TO THERAPY UNIT DATA. Weinkam, J. J.; Kolde, R. A. (Simon Fraser Univ., Burnaby, British Columbia). Comput. Programs Biomed.; 3: 213-229(Dec 1973).

The first formula for computing dose distribution was developed by Sterling et al. for the Eldorado A therapy unit at 80 cm ssd. This formula later evolved into the General Field Equation which was applicable over the entire range of source skin distances. Recently, this equation has been extended to fit the dose distributions of a wide variety of therapy units, including cobalt units, linear accelerators, and betatrons. Fitting the Extended General Field Equation to dose data is a complex task involving the use of nonlinear regression. This paper describes a software package to perform this task. The system is implemented on an IBM 360. The procedure can readily accept either directly measured dose data or digitized data from manufacturer-supplied isodose charts. In addition to the basic task of fitting the equation to the dose data, the program performs a comparison of the computed and observed dose values and an analysis of the error distribution. (auth)

24287 GONAD DOSES IN ROENTGENODIAGNOSTICAL INVESTIGATION OF THE STOMACH DEPENDING UPON ITS LOCATION IN THE ABDOMINAL CAVITY. Kuznetsov, A. I.; Krinitsyn, V. D.; Zubkova, T. I. (Leningrad Scientific-Research Inst. of Radiation Hygiene). Med. Radiol.; 19: No. 8, 27-31(Aug 1974). (In Russian).

Variants of the position of the stomach in the abdominal cavity in 1612 patients of both sexes at an age from 15 to 90 years were studied. A high position of the stomach was observed: in women, 2.5 percent; in men, 16.7 percent; a low position in 42 percent and in 12.7 percent, respectively. It was shown that the age of the patients also influences the position of the stomach in the abdominal cavity. With the lower position of the stomach the roentgenodiagnostical investigation would entail considerable irradiation of the gonads. Moreover, radiation effect on the women's gonads is 5 to 7 times greater than that on the men's. When calculating the values of contribution to the gonad dose and the average gonad dose of roentgenodiagnostical investigations of the stomach taking into consideration its anatomical position in the abdominal cavity, the

average gonad dose for adult patients of both sexes should be increased almost by 4 times. The obtained results make it possible to specify the extent of radiation effect on the gonad of the patients who underwent roentgenodiagnostical investigation of the stomach. A correction was made towards increase of contribution to the gonad dose from this type of roentgenodiagnostical investigation. (auth)

24288 RESULTS WITH BENDAZAC IN RADIATION DERMATITIS. DiPietrantonj, F. (Centro Oncologico, Ancona, Italy). Radiol. Med.; 60: No. 1, 36-41(Jan 1974). (In Italian).

Satisfactory results with a 1% bendazac (1-benzyl-indazol-3-ossiacetic acid) lotion three times a day in 42 cases of skin reaction during telecobalt treatment are reported. (auth)

24289 PROFESSIONAL EXPOSURES TO IONIZING RADIATION IN THE CSSR. Chysky, J. (Inst. of Hygiene and Epidemiology, Prague); Trousil, J. Radioisotopy; 15: No. 3, 367-373(1974). (In Czech).

Personal exposures in Czechoslovak medical, industrial, and research establishments working with radiation sources, as determined by centrally evaluated dosemeters, are very low. The number of persons in which the lowest exposures are found is still increasing. In the year 1964, exposures lower than one-tenth of the MPD were measured in 82.04% of controlled persons. In 1970, these lowest exposures were found already in 92.83% of the controlled persons. The statistical analysis of the measured results reveals, however, groups of workers where the exposures are slightly higher. This applies especially to persons working with industrial gamma defectoscopy and with ^{226}Ra in oncological medical establishments. Increased attention should be paid, therefore, to these groups of workers in the radiation protection practice. An analysis of the collected data has shown that the work with radiation sources involves only a very small probability of exceeding the integral dose of 20 R during 40 years of work with sources of ionizing radiation. We can presume that only a very small portion of persons will exceed during their working life one-tenth of the integral professional dose of 200 R. (auth)

Vertebrates

Refer also to abstracts 24171, 24175, 24181, 24393, and 24395.

24290 (COO-1210-86) ACQUIRED IMMUNOLOGIC TOLERANCE IN CHIMERAS AND HISTOCOMPATIBILITY FACTORS IN CATTLE AND THEIR RELATIONSHIP TO THOSE IN HUMANS. Comprehensive Report, September 15, 1971 - May 15, 1974. Stone, W. H.; Iha, T. H. (Wisconsin Univ., Madison (USA)). 1974. Contract AT(11-1)-1210. 27p. Dep. NTIS $4.50.

Studies on irradiation and transplantation in chimeric cattle twins included determination of effects of gamma radiation on the proportions of the two erythrocyte populations that comprise the chimeric mixture and the effects of radiation on hematologic and physiologic parameters. Chimeric birds were used for studies on tolerance and tissue interaction; chimeras were obtained by making parabionts of embryonating eggs. The following histocompatibility studies were conducted; the use of cattle alloimmune and normal serum as a source of histocompatibility typing sera for humans; human histocompatibility testing with cattle anti-lymphocyte alloimmune sera; antisera from cattle immunized with human lymphocytes and kidney tissues; the mixed lymphocyte culture test with cattle lymphocytes; histocompatibility antigens of cattle lymphocytes; and serum protein allotypes in cattle and birds. (HLW)

24291 (IAEA-R-719-F) HEMOPOIETIC STEM CELL KINETICS AFTER IRRADIATION OF THE MOUSE. Part of a Coordinated Programme of Research on Radiation Hematology. Final Report, 1 November 1968 - 30 November 1970. Lahiri, S. K.; Keizer, H. J.; van Putten, L. M. (International Atomic Energy Agency, Vienna (Austria)). Dec 1970. 14p. INIS.

Cell transplantation and spleen colony formation have been used to study the kinetics of growth of haemopoietic cells in irradiated mice. Before the haemopoietic colony forming cell population starts growing, it suffers a loss in a number, at least partly by differentiation. During the rapid growth phase, there is more self replication than differentiation. An overshoot, which occurs in the spleen but not in the femur, is followed by more differentiation than self-replication. (INIS)

24292 (JPRS-62082, pp 133-135) EFFECT OF PROTAMINE-ADENOSINETRIPHOSPHATE ON THE VIABILITY OF LETHALLY IRRADIATED RATS. Pantev, T. P.; Bokova, N. V.; Nikolov, I. T. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 2, 85-86(1974).

Data in the literature indicate a radioprotective effect of simple proteins (protamines, isolated from nuclei of the sperm cells of some fish; sturine from sturgeon; and salmin from salmon). The degree of the protective effect of protamines is dependent to a high degree on the type of their salts. For example, for sturine the effectiveness, depending on the anion residue, decreases in the following sequence: sulfate > hydrochloride > ascorbinate. This dependence does not conform to simple stoichiometric changes in the quantity of introduced protein. In addition, with the joint use of different salts of sturine and L-cysteine one can observe an increase in radioprotective properties; the effect, regardless of the type of anion part, is always virtually identical. Data are presented on the synthesis of protamine-adenosinetriphosphate (PATP) and the results of an experimental study of its protective properties in lethally irradiated rats in which protamine isolated from sperm of the salmon was used. (CH)

24293 (JPRS-62553) SPACE BIOLOGY AND AEROSPACE MEDICINE, Vol. 8, No. 3, 1974. Translation of Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 3-90(1974). 152p. NTIS.

Separate abstracts were prepared for 7 of the 29 papers included. Other papers discuss the physiological effects of the space environment on experimental animals. (CH)

For abstracts of individual papers see: 24175, 24215, 24294-24297, and 24867.

24294 (JPRS-62553, pp 14-19) EFFECTIVENESS OF ADMINISTRATION OF AMYTETRAVITE AND ATP DURING PROLONGED IRRADIATION. Rogozkin, V. D.; Tikhomirova, M. V.; Davydova, S. A.; Vodyakova, L. M.; Ostroumova, L. M.; Atamanova, O. M. 24 Jul 1974. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 11-14(1974).

In experiments on 109 dogs exposed to prolonged γ irradiation with a dose rate of 1 R/min the effectiveness of protection from long-term (two weeks) administration of amytetravite in combination with ATP was studied. The combined effect of the preparations was investigated for two irradiation doses: 800 R ($LD_{95/45}$) and 700 R ($LD_{75/45}$). Repeated preventive use of amytetravite increasing the body resistance noticeably and enhanced the protective effect of ATP. This was manifested in an increase in the survival rate, a decrease in the severity of radiation sickness, and a decline in the level of hematological changes in comparison with the effect of ATP administered alone. Enhancement of the protective effect of ATP combined with amytetravite was more noticeable in the case of a dose of 700 R. The survival rate of the animals given both preparations was 93%, whereas that of the dogs given ATP alone was 60%. Combined treatment with ATP and amytetravite, as well as with ATP alone, prevented an increase in the level of 11-hydroxycorticosteroids in the peripheral blood during the culmination of sickness which was typical of the control dogs. (auth)

24295 (JPRS-62553, pp 125-127) ULTRAVIOLET FLUORESCENCE OF MYELOID CELLS IN THE BONE MARROW OF DOGS EXPOSED TO CHRONIC RADIATION. Aleksandrov, S. N.; Safronova, V. G.; Yagunov, A. S. 24 Jul 1974. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 78-79(1974).

Among the offspring of γ irradiated dogs first-generation animals from the cross-breeding of irradiated males with intact females were selected for investigation. The results of experiments on these dogs subjected to chronic irradiation at a low-intensity dose established that the radiation changes determining the increase in the intensity of ultraviolet fluorescence of bone marrow cells, and possibly other types of somatic cells, are transmitted in the sexual multiplication of animals and attain a mass appearance, although impairments in the genetic determinants causing them are in a heterozygotic state. (auth)

24296 (JPRS-62553, pp 136-140) INFLUENCE OF FUNCTIONAL LOADS ON THE STATE OF THE PHAGOCYTIC FUNCTION OF BLOOD IN DOGS SUBJECTED TO CHRONIC γ IRRADIATION. Shilov, V. M.; Markelov, B. A.; Pal'mina, S. I. 24 Jul 1974. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 83-85(1974).

The effects of chronic γ irradiation, with and without the effects of biological stress resulting from running a treadmill, on the phagocytic function of blood neutrophils were studied in dogs. Chronic irradiation at a dose of 125 rad/yr over a period of 3.5 years led to a decrease in phagocytic activity while chronic irradiation at a dose of 188 rad/yr and subjection to biological stress during the same period of time resulted in only brief periods of depression of phagocytic activity. (CH)

24297 (JPRS-62553, pp 145-147) THERMAL TOLERANCE OF BLOOD SERUM IN DOGS SUBJECTED TO COMBINED EXPOSURE TO X RADIATION AND REDUCED BAROMETRIC PRESSURE. Vashuk, A. A. 24 Jul 1974. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 88-90(1974).

Experiments on the combined effects of x irradiation and barometric pressure on the thermal tolerance of blood serum were carried out in dogs. The first-group animals were subjected three times in a row to the influence of reduced barometric pressure (267 mm Hg) for a total period of seven hours. On the first day the animals were in a pressure chamber for two hours and during the next two days for 2½ hours. The second-group animals were subjected to a single total irradiation with x rays at doses of 100, 350, and 700 R. The third-group animals on the first, second, and third days after irradiation at doses of 100, 350, and 700 R were exposed to reduced pressure under the same conditions as first-group animals. The thermal tolerance of blood serum was ascertained from its thermal coagulation time at a heating temperature of 67 ± 0.1°C. The results of these investigations revealed that the exposure of the unirradiated animals to reduced barometric pressure in general caused a decrease in the time of thermal coagulation. After irradiation at doses of 350 and 700 R there was a significant increase (by 14 to 16 and 24 to 28%, respectively) in thermal stability. Later in the animals subjected to irradiation at a dose of 350 R the time of thermal coagulation increased and attained a maximum by the 13th to 20th days after irradiation. (auth)

24298 (LA-5633-PR, pp 1-19) MAMMALIAN RADIOBIOLOGY. May 1974.

In annual report of the Biomedical and Environmental Research Program.

The activities of the Mammalian Radiobiology Group (H-4) consist primarily of programmatic research with major emphasis on effects of radiation from both external and internal sources on mammals and appropriate extrapolations to man. Investigations on the effects of radiation from external sources were concerned largely with the injury and repair of radiation damage to bone marrow produced by sublethal and lethal radiation exposure. Current emphasis is on low-dose-rate irradiation. Rodents, dogs, and monkeys were used in studies that are oriented programmatically toward civil defense, manned space flight, military, and emergency radiation exposure situations. Research activities on the effects of internally deposited radioactive materials include interspecies correlations (rodents, dogs, monkeys, and extrapolations to man) of uptake, deposition, and excretion of radioisotopes. Much emphasis currently was on the response of various body tissues (especially the lung) to high specific-activity particulate transuranium radionuclides (such as plutonium-238 and plutonium-239 oxide). One additional programmatic objective was the establishment of radiation protection guides for internally deposited radioisotopes in man. These activities are programmatic to the control of worker exposure to radioactive materials. Other research efforts were related to animal radiobiology studies of negative pions for preclinical therapy work to be conducted at the biomedical addition at LAMPF. (auth)

24299 (UCSF-34-P-53-X-4) MATERNAL-EMBRYO INTERACTIONS DURING MAMMALIAN DEVELOPMENT. Final Progress Report. Glass, L. E. (California Univ., San Francisco (USA)). 8 Jul 1974. Contract AT(11-1)-34. 4p. Dep. NTIS $4.00.

Progress is reported on the following studies: differentiation of effects on developing embryos resulting from non-maternal x-radiation damage of the egg or embryo as contrasted with those resulting from damage to the maternal organism; radiosensitivity of tubal oocytes and embryos at different developmental stages; effects of x radiation on molecular differentiation of mouse tubal embryos and oviductal epithelium; and effects of x radiation on transfer of maternally-synthesized macromolecules to mammalian oocytes, embryos, and fetuses. (HLW)

24300 ORGANIC ACIDS AS METABOLIC INDICATORS. III. The Metabolism of ^{14}C-Propionate in Rats Exposed to Irradiation and Thermal Injuries. Henderson, T. R.; Jones, R. K. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). J. Trauma; 14: No. 4, 305-316(Apr 1974).

^{14}C-propionate utilization was found to be a useful in vivo indicator of the severity of burn or irradiation injuries and the extent of recovery from such injuries. Flash burns (9.2 cal/cm^2, 30% of body area) or gamma irradiation (750 rad) produced a significantly reduced rate of $^{14}CO_2$ production from 1-^{14}C-propionate during the initial shock phase following exposure. Recovery from nonlethal injuries was associated with recovery of ability to oxidize propionate within 1 to 2 weeks. In the case of animals exposed to irradiation plus flash burns, a greater initial decrease in propionate oxidation was noted, and recovery did not occur. The persistence of decreased rates of propionate oxidation was often correlated with early mortality. Analysis of urinary organic acid excretion patterns showed that healthy rats excreted mainly ^{14}C-citrate after being injected with ^{14}C-propionate. Following exposure to injury, the excretion of ^{14}C-citrate was sharply reduced. Recovery of citrate excretion to normal ensued in 2 to 7 days in animals exposed to nonlethal flash burns or gamma irradiation alone, but little recovery was noted in animals exposed to both injuries. It was concluded that a deficiency of Krebs cycle intermediates was a significant characteristic of the initial metabolic state or "ebb" phase following injuries, and that biochemical events sensitive to irradiation were involved in recovery. Measurements of the rate and pathway of propionate utilization appeared to be a useful physiological monitor for estimating the extent of recovery from thermal burns. (auth)

24301 CELLULAR REPOPULATION IN IRRADIATED MOUSE THYMUS AND BONE MARROW. Hiesche, K. D.; Revesz, L. (Kungliga Karolinska Mediko-Kirurgiska Institutet, Stockholm (Sweden). Institutionen foer Tumoerbiologi). Beitr. Pathol.; 151: No. 3, 304-316(1974).

4 figs.; 1 tab.; 33 refs.

Cellular repopulation of thymus and bone marrow was investigated in mice after x-irradiation. The animals had either one leg shielded during irradiation for varying lengths of time, or were transplanted with syngeneic bone marrow cells in graded numbers immediately after radiation treatment. During the first 12 days after treatment thymic repopulation was largely independent of the number of bone marrow cells available in the organism. Thereafter repopulation proceeded in relation to the number of the bone marrow cells present. In contrast to the thymus, cellular restoration of the bone marrow was directly related to the number of the protected or transplanted marrow cells from the beginning. An indirect effect of radiation on the regeneration pattern of the population of small size bone marrow cells, comprising largely lymphoid elements, was noted. (auth)

24302 BIOGENESIS OF BRUSH BORDER MEMBRANES: ALKALINE PHOSPHATASE AND AMINOPEPTIDASE AND THEIR POSSIBLE PRECURSOR PROTEINS AFTER X-RAY IRRADIATION OF SMALL INTESTINE OF C3H MICE. Wachsmuth, E. D.; Torhorst, A. (Friedrich-Miescher-Institut, Basel (Switzerland); Technische Univ. Muenchen (F. R. Germany). Inst. fuer Pathologie). Beitr. Pathol.; 151: No. 3, 234-247(1974).

5 figs.; 21 refs. Part of a thesis by A. Torhorst.

Putative proteins of brush border membrane enzymes were recently discovered in the cytoplasm of crypt cells of the small intestine, and of proximal convoluted tubules of kidney. This finding was confirmed in mice after 1,200 r x irradiation, which is known to upset the protein synthesis. The hydrolytically active enzymes, aminopeptidase and alkaline phosphatase, were analyzed in homogenates and localized in tissue sections with histochemical methods. The localization of the hydrolytically inactive precursor proteins was demonstrated using a recently described immunohistochemical method. An effect of x irradiation could be seen only in the small intestine and not in the kidney. In the early degeneration phase both the putative precursor proteins and their enzymes increased. In the late degeneration phase the putative precursors disappeared first from the crypts of duodenum and ileum, followed by the hydrolytically active enzymes in the brush border membrane of the villi. In the regeneration phase the putative precursor proteins had already reappeared when the hydrolytically active enzymes became detectable in the villi membrane. The appearance of cytoplasmic putative precursor proteins were a prerequisite for the appearance of brush border membrane enzymes. This is consistent with their being true precursor proteins. (auth)

24303 THE RELATION OF AGING TO RADIOPROTECTIVE EFFECTS INDUCED BY CYSTEAMINE IN THE LIVERS OF WHITE MICE. Mitznegg, P. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Pharmakologisches Inst.). Actuelle Gerontol.; 3: No. 12, 753-756(Dec 1973). (In German).

2 figs.; 4 refs.

The i.p. administration of 150 mg/kg cysteamine leads to a transient inhibition of ^{3}H-thymidine incorporation into DNA of liver cells in 5-week-old mice. This functional suspension of DNA synthesis seems likely to be responsible for cysteamine-induced radioprotective effects, i.e. the acceleration of DNA restoration and the prevention of loss in liver weight and in the total liver contents of DNA, RNA, and proteins 4 and 8 days after a total body gamma-irradiation with 500 rads. In two-year-old senile animals, however, where cysteamine to the contrary in the young mice increases DNA synthesis, no radioprotection occurs after pre-irradiation treatment with cysteamine. (auth)

24304 INVESTIGATIONS ON THE ALTERED EFFECT OF VASOCONSTRICTIVE AND ANTIARRHYTHMIC DRUGS IN IRRADIATED RATS. Danysz, A.; Szaykowski, A.; Szmal, Z. (Instytut Lekow, Warsaw (Poland). Zaklad Lekow Izotopowych). Strahlentherapie; 147: No. 4, 437-445(Apr 1974). (In German).

4 figs.; 2 tabs.; 53 refs.

The altered effect of two vasoconstrictive and myotonic peptides, vasopressin and hypertensin, and the two antiarrhythmic agents, quinidine and procaine, was investigated during the acute radiation syndrome. In irradiated rats, the hypertensive action of vasopressin and hypertensin is lower in general. Vasopressin also has a less vasoconstrictive effect on the vessels of the isolated extremities of irradiated rats. The acute decrease in blood pressure by venesection normalizes the reactivity of the irradiated animals to hypertensin. Whole-body irradiation causes a reduced sensibility to the arrhythmogenic effect of calcium chloride, in particular in the 6th and 9th day following irradiation. Quinidine has no antiarrhythmic effect if quinidine is normalized. Procaine intensifies the arrhythmogenic effect of calcium chloride in irradiated rats on the 6th and 9th day following irradiation, on the 15th day, however, it has no significant antiarrhythmic effect. These results prove that in rats irradiated with sublethal doses the reactivity on hypertensive (myotonic) arrhythmogenic ($CaCl_2$) and antiarrhythmic agents is significantly altered. (auth)

24305 EFFECT OF IONIZING RADIATION ON THE BIOLOGICAL CONDITION OF FISH. Shekhanova, I. A.; Voronina, E. A.; Klyashtorin, L. B.; Pechkurenkov, V. L.; Yarzhombek, A. A. pp 7-24 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Problems related to effects of radioactive environmental contamination of fish populations are discussed. While determining the effect of dissolved radionuclides on the eggs the counts of dead or disfigured embryos fail to provide valid assessment. The count of occurrences of distorted chromosomes in embryos is suggested as a more reliable criterium. In fact, the number of aberrant anaphases increases at specific activities over 10^{-3} Ci/l. At such activities the metabolic rate in the developing eggs of Misgurnus fossilis tends to increase. No influence of dissolved radionuclides on the metabolic rate under hypoxial stress was revealed. Keeping of fish in radionuclide solutions for a long time resulted in partial sterilization of males and reduction in the numerical strength of generations at the specific activities of 10^{-6} Ci/l. (auth)

24306 INFLUENCE OF γ-RAYS AND TEMPORARY FACTOR ON PLANKTONIC BIOCENOSIS. Razyulite, R. N.; Yankyavichyus, K. K.; Saulenaite-Budriene, S. F.; Yankavichyute, G. Yu. pp 73-77 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Data of a 79 day experiment show that a 1000 kR dose is not sterilizing for bacterio- and phytoplankton while zooplankton may be killed even by a 20 kR dosage. Bacteriologically pure cultures of algae appear to be more susceptible to irradiation than algae from planktonic biocenosis. Different algal species did not respond to doses of γ radiation in the same way. The amount of free amino acids in the cells and in algal medium depends on intensity of the development of algae. (auth)

24307 SPONTANEOUS CHROMOSOME CHANGEABILITY OF PELAGIC ANIMALS IN ATLANTIC AND PACIFIC OCEANS. Tsypugina, V. G. pp 95-101 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Spontaneous translocations of chromosomes in embryos of three fish species from Caribbean and tropics of Atlantic and Pacific as well as in Velella velella from equatorial Pacific were studied. Frequency of nuclear destructions and variability of this parameter is relatively higher for Pacific organisms. It is, perhaps, an evidence of the action of environmental mutagenic factors on the mutagenic process as well as of a difference in individual sensibility of specimens to this action. (auth)

24308 SEROLOGIC AND PATHOMORPHOLOGIC ASPECT OF THE AUTOIMMUNIZATION PROCESS IN EXPERIMENTAL TUBERCULOSIS IN GUINEA PIGS EXPOSED TO FRACTIONATED GAMMA-IRRADIATION AND TREATED WITH ISONIAZID. Valcanov, V.; Vasilev, V. N.; Kehajov, I. R. Izv. Mikrobiol. Inst., Bulg. Akad. Nauk.; 23: 101-111(1972). (In Russian).

Serologic and morphologic investigations were undertaken in guinea pigs inoculated with M. tuberculosis, strain $H_{37}R_V$, and exposed to fractionated gamma irradiation (6 procedures of 10 rad each at intervals of 9 days), treated with isoniazid (10 mg/kg weight). The immune response to the tissue autoallergens produced was followed up by the complement fixation test and Boyden's passive hemagglutination test. The incidence of complement-fixing and hemagglutinating auto-antibodies against lung, spleen, brain, and testis was higher in tubercular guinea pigs exposed to low fractionated doses, than in nonirradiated infected animals. Isoniazid treatment led to a decrease in the frequency with which autoantigenicity arises and hence of autoantibody production. (Abstr. Bulg. Sci. Med. Lit.)

24309 DEMONSTRATION OF RADIOSENSITIZATION OF HYPOXIC CELLS IN SOLID TUMOURS BY METRONIDAZOLE. Begg, A. C.; Sheldon, P. W.; Foster, J. L. (Mount Vernon Hospital, Northwood, Eng.). Brit. J. Radiol.; 47: No. 559, 399-404 (Jul 1974).

Significant radiosensitization of naturally occurring hypoxic cells by metronidazole ("Flagyl") was demonstrated in two contrasting types of solid murine tumors, and at concentrations producing little toxicity. In first-generation transplanted mammary carcinomas in C_3H mice the x-ray dose required to control half the irradiated tumors at 150 days was reduced by a factor of 1.36. In a fast-growing serially transplanted sarcoma "F" in CBA mice the enhancement ratio, estimated from rates of loss of ^{125}IUdR from the tumors in vivo was also at least 1.3. The peak serum concentrations of metronidazole during the irradiation were 480 and 460 μg/ml respectively. These are high concentrations and future work with hypoxic cell sensitizers should aim at achieving sensitization for smaller amounts of drug administered. (auth)

24310 EFFECT OF CYCLOHEXIMIDE AND X-IRRADIATION ON IN VIVO PROTEIN SYNTHESIS BY PLACENTA AND MATERNAL LIVER OF MICE. Tarachand, U.; Eapen, J. (Bhabha Atomic Research Centre, Bombay). Strahlentherapie; 147: No. 1, 97-100 (Jan 1974).

In vivo incorporation of leucine-1-^{14}C into proteins of placenta and liver of 15-day pregnant mice is inhibited 2 hours following administration of cycloheximide at concentrations of 4, 8, and 12 mg/kg body weight. The degree of inhibition resulting from these three doses is almost the same, but a lower concentration, namely 1 mg/kg body weight, has no effect on placenta, but enhances incorporation into hepatic proteins. Cycloheximide (4 mg/kg body weight) treatment and x-irradiation (1,000 R), in combination, counteract the inhibitory effect of each other on leucine incorporation into both hepatic and placental proteins to give values which are nearly normal. (GE)

24311 SOMATIC EFFECTS IN THE ACTION OF ^{241}Am ON ANIMALS. Rudnitskaya, E. I.; Moskalev, Yu. I. Gig. Sanit.; No. 4, 46-50(Apr 1974). (In Russian).

Death in dogs following acute injury from 0.06 to 0.01 μCi/g doses of $AmCl_3$ is due to an agranulocyte syndrome. With subacute and chronic doses of ^{241}Am in dogs (in 100% of the cases), cirrhosis of the liver develops with portal hypertension. Acute and chronic radiation sickness show cardiovascular insufficiency symptoms. Neoplasias develop, at different times, in 50% of the cases. The microgeometry of ^{241}Am dispersion in the liver, medullary regions of the kidneys, and hematogenic organs differs in the formation of dense "stars" which play an important role in the development of remote sequelae. (tr-auth)

24312 JOINT ACTION OF X RADIATION AND INHIBITORS OF RADICAL REACTIONS ON A TUMOR AND THE ORGANISM OF A TUMOR-BEARING ANIMAL. Burlakova, E. B.; Gaintseva, V. D.; Pal'mina, N. P. (Inst. of Chemical Physics, Moscow). Dokl. Biol. Sci.; 213: No. 1-6, 494-496(1973).

Translated from Dokl. Akad. Nauk SSSR; 213: No. 6, 1451-1453 (Dec 1973).

At intervals following transplantation of leukemia and hepatomas, mice were given 200 to 700 R doses of whole-body x radiation and 4-methyl-2,6-ditert-butylphenol(ionol). Graphs are presented to show tumor growth and survival curves of the animals. With increasing doses of radiation, increased inhibition of tumor growth occurred and the average life span of the animals decreased. Higher doses of the inhibitor caused an intensification of the effects of radiation. (HLW)

24313 EFFECT OF RADIATION ON THE HEMATOPOIETIC TISSUE. II. Hajdukovic, S.; Szirmai, E. (Boris Kidric Inst., Belgrade). J. Inst. Nucl. Eng.; 15: No. 3, 79-81(May 1974).

This paper is a continuation of that published in Vol. 15, No. 1, p. 17 (1974), and deals mainly with the time sequence of the effects of radiation on the various types of blood cells. (UK)

24314 LATE EFFECTS OF SPINAL CORD IRRADIATION WITH 300 kV X RAY AND 15 MeV NEUTRONS. van der Kogel, A. J.; Barendsen, G. W. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). Brit. J. Radiol.; 47: No. 559, 393-398(Jul 1974).

Dose-effect relationships were determined for late damage caused by local irradiations of the spinal cord of rats with single and fractionated doses of 300-kV x rays and 15-MeV neutrons. After latent periods of 4 to 12 months, symptoms of myelopathy develop. The latent period decreases with increasing dose, but rapidly reaches a minimum of four months with both x-rays and neutrons. The relative biological effectiveness of 15 MeV neutrons

is 1.1 for single irradiation and 1.7 for irradiation in five fractions. For x-rays, the total dose required increases with the number of daily fractions. The main histological changes consist of degeneration of the nerve roots if the lumbar region was irradiated. Irradiation of the cervical region resulted in focal necrosis of the white matter. An analysis of the data with respect to an hypothesis about the mechanism through which damage to the spinal cord may develop, is given. (auth)

24315 RADIOPROTECTIVE EFFECT OF SOLCOSERYL. Bauer, D.; Locker, A. (Inst. for Biology, Seibersdorf, Austria). Experientia; 30: No. 6, 643(15 Jun 1974).

Mice were pretreated with Solcoseryl, a low-molecular-weight compound extracted from deproteinized blood of spring calves, and 60 min later were given a single whole-body dose of gamma radiation. After 30 days there was practically no survival in untreated controls, while nearly all of the treated animals survived. (HLW)

24316 RADIOPROTECTIVE EFFECT OF CYTRIPHOS UNDER CONDITIONS OF FRACTIONATED EXPOSURE TO X RAYS. Bokova, N.; Pantev, T.; Nikolov, I. Rentgenol. Radiol.; 12: No. 2, 129-134(1973).

The radioprotective properties of Cytriphos were studied on mice exposed to triple irradiation with 400 R at three-day intervals between procedures. The compound was introduced 15 min before each exposure in a dose of 700 mg/kg. The total irradiation dose of 1200 R in this fractionation scheme was absolutely lethal for control animals. The survival rate was much higher and the main duration of life much longer in Cytriphos-protected animals. Parallel studies were devoted to the effect of Cytriphos on bone marrow, spleen and thymus cellularity, splenic and small intestinal weight, and the dynamics of the body weight changes in protected and in irradiated animals. (Abstr. Bulg. Sci. Med. Lit.)

24317 RESPONSES OF METAMORPHOSING TARICHI TOROSA TO X-RAYS. McCurdy, H. M.; Algard, F. T.; Friedmann, G. B. (Univ. of Victoria, British Columbia). Can. J. Zool.; 52: No. 6, 671-676(Jun 1974).

A single dose of 1000 rads of x rays administered to metamorphosing Taricha torosa larvae interferes selectively with some elements of the metamorphosing process without, apparently, affecting any major triggering mechanism. Though the predominant result is a failure to complete metamorphosis, metamorphosed irradiates showing larval pigmentation, vestigial gills, and nonprotuberant eyes have been observed. Arrest of the normal thickening of the epidermis during metamorphosis and of the associated development of the epidermal melanophores is followed by regression of the pigment pattern to the larval form. This 1000-rad dose appears to kill half of a sample population in 30 days. A single dose of 200 rads, while allowing completion of metamorphosis, is fatal within some 3 months. The metamorphosed animals show predominantly adult characteristics. (auth)

24318 INJURY TO CELL MEMBRANES BY PENETRATING RADIATION. Danilov, V. S.; Kozlov, Yu. P. pp 14-25 of O Mekhanizmakh Prirod. I Modifitsor. Radiochuvstvitel'nosti. Moscow; Moscow State University (1973). (In Russian).

Experiments were performed on white rats. The animals received whole-body irradiation in a GIBE-800 (34 r/min). Nuclei, mitochondria, and microsomes were isolated from the liver by differential centrifugation. Lipids were isolated from liver tissue organelles by Foltsch's method. Irradiation stimulated oxidative reactions in all the liver organelles. Peroxidation of the lipids proceeded more intensively in the liver mitochondria and microsomes. The nuclear lipids were less labile. Accumulating in the lysosome membranes, the peroxides destroyed them, thereby facilitating the escape of hydrolytic enzymes from the organelle. This resulted in sharp intensification of the hydrolytic processes and autolysis in the animal's tissues. The pathological excess of normal amounts of lipid peroxides in the organelles increased the accumulation of the peroxidation products of the lipids, aldehydes, ketones, and epoxides, which together with toxins of nonlipid nature resulted in general toxicosis of the cell. (Referativnyi Zh.)

24319 QUANTITATIVE RELATION OF THE EFFECT OF TOTAL FAST ELECTRON DOSE AND NUMBER OF FRACTIONAL DOSES IN EHRLICH CARCINOMA IRRADIATION. Kozlov, A. P.; Akimov, A. A.; Pertsov, O. L. Vop. Onkol.; 19: No. 3, 94-96 (1973). (In Russian).

The anticarcinogenic effect of high-energy electrons on Ehrlich carcinoma in white mice decreased with increasing fractionation of the dose. The effect is related to the number of fractions by the 0.44 power of the number ($N^{0.44}$). (tr-auth)

24320 EFFECTS OF CYSTEAMINE AND AET Cl HCl ON THE INDUCTION OF MEIOTIC CHROMOSOME REARRANGEMENTS IN IRRADIATED MALE MICE. Savkovic, N.; Pecevski, J. (Boris Kidric Inst., Belgrade). Can. J. Genet. Cytol.; 16: No. 1, 85-89(Mar 1974).

Two established chemical protective agents, β-mercaptoethylamine (cysteamine) and β-aminoethylisothiuronium (AET) Cl HCl were tested for their ability to induce chromosome translocations in totally irradiated mice with 600 R. The purpose of this investigation was to determine whether cysteamine and AET Cl HCl themselves induce reciprocal translocations and whether these chemical agents have an equally protective effect against x-ray-induced chromosomal translocations in the first meiotic metaphase. The incidence of translocations after whole-body irradiation with a 600 R was 9.07% in animals protected with cysteamine and irradiated 3.68%, and in those protected with AET Cl HCl and irradiated with the same dose, 5.45%. Not a single chromosome rearrangement was recorded among the animals treated with cysteamine and AET without irradiation. (auth)

24321 HEMATOPOIETIC STEM CELL AND ITS DIFFERENTIATION. Viktora, L. (Inst. of Hematology and Blood Transfusion, Prague). Cesk. Fysiol.; 21: No. 5, 431-436(1972). (In Czech).

A review is presented of current knowledge of the hematopoietic stem cell and its differentiation. Attention is focused on the spleen colony formation in lethally irradiated mice after bone marrow cell transplantation, and various factors influencing conditioning or facilitating the proliferation of stem cells are discussed. (Nuclear Sci. Abstr. Czech.)

24322 INNER CLOCK, A MYSTERY. Hintsches, E. MPG (Max-Planck-Ges.) Presseinform.; No. 10, 1-8(1973). (In German).

Within the complex of the not yet fully examined inner clock of living organisms, the influence of the time of day on the sensitivity to exterior stimulation, also to irradiation is discussed. For example, the same whole-body dose given in the evening at 21 h killed rats within 13 hours, while if given at 9 h in the morning, resulted in a survival time of more than 120 days. It is thus recommended to give greater importance than has been done up to now to the biological time period in all therapeutical measures such as radiation therapy. (GE)

24323 RESTORATIVE EFFECT OF PERITONEAL MACROPHAGES ON DELAYED HYPERSENSITIVITY FOLLOWING IONIZING RADIATION. Volkman, A.; Collins, F. M. (Trudean Inst., Saranac Lake, NY). Cell. Immunol.; 2: 552-566(Dec 1971).

Sublethal whole-body irradiation in the guinea pig had little demonstrable effect on the development of delayed hypersensitivity but caused a profound, though transient depression of dermal reactivity in previously sensitized animals. Macrophage-rich peritoneal cell suspensions from non-sensitive donors when injected intradermally with eliciting antigen, resulted in the restoration of a significant degree of reactivity following irradiation. Inocula of lymphocytes, on the other hand, failed to yield similar results. These findings, when taken with the persistence of low levels of reactivity following irradiation and the ability to transfer reactivity with peritoneal exudate cells from animals so treated, warrant the conclusion that the presence of macrophages is necessary for the expression of cutaneous delayed hypersensitivity. The spontaneously renewed activity which follows the depressed phase is thus more of a reflection of the recovery of macrophage precursors from radiation injury, rather than the emergence of a new population of sensitized cells. The results, in addition, substantiate the belief that the expression of delayed hypersensitivity requires at least two cell populations, only one of which carries the property of specificity at the outset. The presence of the sensitized population cannot always be excluded by a weak or absent skin test. (auth)

24324 ESR SIGNALS DURING X IRRADIATION OF TISSUES: THEIR CHARACTERISTICS AND RELATIONSHIP TO THE CANCEROUS STATE. Floyd, R. A.; Bronsdon, A.; Commoner, B. (Washington Univ., St. Louis). Ann. N. Y. Acad. Sci.; 222: 1077-1086(31 Dec 1973).

Testes tissue from rats was irradiated and ESR observations were made under anaerobic conditions. In one experiment ascorbate was added to the tissue and the effects of various redox systems on the intensity of the ascorbate signal were studied. Other factors having an influence on the intensity of the radioinduced signal were as follows: temperature, addition of free flavin, AET, and MEA. Other experiments were conducted on rat livers and tumors of rat livers. Normal liver tissue did not exhibit the ascorbate free radical on irradiation, but the tumor tissue did. Results of all experiments are shown by means of graphs. (HLW)

24325 ASSOCIATION OF SULFO-MUCOPOLYSACCHARIDES WITH HISTOGENESIS OF ENDOCARDIAL SWELLINGS (CUSHION TISSUES) IN NORMAL AND ABNORMAL DEVELOPING RAT

HEARTS. Ueno, T. (Hiroshima Univ.). Med. J. Hiroshima Univ.; 21: No. 9-10, 619-644(Oct 1973). (In Japanese).

Pregnant rats were irradiated with 14.1-MeV fast neutrons (130 rad) 8 days after conception. The relationship between the morphological developments and sulpho-mucopolysaccharides (SMPS) in the endocardial swellings was studied with autoradiography. Pregnant rats were given single intraperitoneal injections of 5 Ci/g Na_2 $^{35}SO_4$ 10 to 15 days after conception. Twenty-four hrs after an injection, serial sections of the embryonic heart were obtained and observed histologically. In the irradiated group, of the total of 36 cases, abnormal loops were observed. Transposition complexes were observed in 70.0% of the cases at 15-16 days. Cell density gradually increased with the embryonic age. Fibrous changes appeared at 15 to 16 days. With histoautoradiography in the endocardial swellings, ^{35}S-grain counts were generally higher in the irradiated group in comparison with those in the control group. It may be suggested that the SMPS is probably produced in the mesenchymal cells during the formation of the endocardial swellings, and the pattern of formation of the SMPS differs in all swellings. The decrease of the physiological degenerative cells in the conus swellings, the abnormal formation of the SMPS synthesis, and the retardation of cell proliferation in each swelling, induced by fast neutron irradiation are suggested to have close relationships with the formation of abnormal loops. (JA)

24326 FUNCTIONAL ANATOMIC CONSEQUENCES OF LOCALIZED INTESTINAL IRRADIATIONS. Santini, R.; Brard, E.; Killian, J. (Institut National des Sciences Appliquees, Villeurbanne, France). Compt. Rend. Soc. Biol.; 167: No. 6, 992-996 (1973). (In French).

The muscular and intramuscular nerve tissues of the intestine do not undergo any microscopically visible modifications when irradiated with 800 R of x radiation. In vitro and in vivo studies do not reveal any modifications to the basic electrical activities observed, the only traumatic effects of the radiation being in the form of changes in the fast electrical activity. An inhibition phase takes place during the first few days following irradiation; this inhibition gradually disappears from the third day onwards and is replaced by an above normal activity. These hyperexcitability phenomena can probably be attributed to a compensatory effect following the inhibition phase and may account for diarrhetic states resulting from irradiation. (FR)

24327 EFFECT OF PRENATAL IRRADIATION ON THE FERTILITY OF MALE AND FEMALE MICE. Leonard, A.; Deknudt, G.; Ivanov, B. (CEN, Mol, Belg.). Compt. Rend. Soc. Biol.; 167: No. 11, 1690-1693(1973). (In French).

Gravid mice, C57B1, were irradiated on the 13½ day of gestation with 100 to 300 R of x radiation. At this stage during the development, the reproductive cells of the embryos are in the primordial state. No increase in prenatal mortality was observed although a sensible increase in the number of deaths between birth and the end of weaning occurred. The fertility of these mice (both males and females) in the adult stage was tested by examining the generations produced during 100 days by interbreeding with unirradiated reference mice of the same strain. It is concluded that the number of young per litter is not significantly modified, but that the number of litters produced varies with the in utero radiation dose. (FR)

24328 INDICATORS OF BIOLOGICAL AGING OF WHITE RATS DURING FRACTIONATED X IRRADIATION. Kolomiichuk, T. V. Dokl. Akad. Nauk BSSR; 18: No. 6, 565-567(1974). (In Russian).

The possible use of fractionated x radiation for stimulation of accelerated aging in white rats and the investigation on this model of some indicators of biological aging were examined. Among the indicators examined are relative weight of the gastrocnemius muscle, sorptive capacities of the tissues, ratio of the free cholesterol to the phospholipids in the liver, ratio of the albumin to the globulins in the blood serum, and concentration of oxidized glutathione in the blood. (tr-auth)

24329 EFFECT OF IRRADIATION ON NORMAL ORGANS. Effect of X-Irradiation on the Excretion Function of Rat Liver. Bando, K. (Tokushima Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 1, 58-70(Jan 1974). (In Japanese).

The liver function of a rat after a whole body irradiation, local irradiation on liver, and whole body irradiation with liver shielded was examined by ^{131}I-Rose Bengal (^{131}IRB) method using a scintillation camera. The effect of prior administration of some chemicals on excretion of ^{131}IRB after irradiation was also studied. ^{131}IRB excretion occurred in two phases; the first phase (E_1) and the second phase (E). The excretion curve was dissociated into two exponential components; the line corresponding to the second phase (E) and the line of the difference between the first and second phase lines (E_1-E). In non-irradiated rats, the mean excretion time for E (T_E) was 64.8 min and the mean excretion time for the [E_1-E] (T_E-E) was 19.3 min. The mean excretion time (T_E) was markedly prolonged at 3, 6, and 24 hr after whole body irradiation of 1000 rad. At 6 hr after local irradiation on liver with 1000 rad, prolongation of the mean excretion time (T_E) was clearly observed, but its extent was less than that in rats given a whole body irradiation. After a whole-body irradiation with liver shielded, ^{131}IRB excretion was prolonged only slightly. Significant prolongation of ^{131}IRB excretion following whole body irradiation is considered to be due to the direct and indirect effect of irradiation on liver. Radiation-induced prolongation of ^{131}IRB excretion was reduced by prior administration of glutathione, adrenochrome or tranexamic acid. (auth)

24330 EFFECT OF RNA AND ITS HYDROLYSATES ON THE CONTENT AND RATE OF RENEWAL OF PHOSPHOPROTEINS AFTER RADIATION LESIONS. Sopin, E. F.; Tsudzevich, B. O. Visn. Kiiv. Univ., Ser. Biol.; No. 15, 3-7(1973). (In Ukrainian).

After whole-body x-irradiation of guinea pigs at 500 R, the content of liver and spleen phosphoproteins decreased while the rate of their metabolism increased during almost all the intervals investigated. Yeast RNA and its hydrolysates increased the content of phosphoproteins in the liver and spleen of the irradiated guinea pigs, bringing it close to normal. They also helped to stabilize the rate of renewal of the phosphoprotein phosphorus during almost all the intervals investigated. The injection of yeast RNA prolonged the lives of the irradiated guinea pigs to 15 to 25 days. The irradiated control generally died in 10 to 12 days. (Referativnyi Zh.)

24331 PEROXIDATION OF PHOSPHOLIPIDS IN LIVER CELL MEMBRANES AFTER IONIZING RADIATION. Sitkovskii, M. V.; Kagan, V. E.; Turovetskii, V. B.; Glushchenko, N. N.; Danilov, V. S.; Kozlov, Yu. P. pp 26-39 of O Mekhanizmakh Prirod. I Modifitsor. Radiochuvstvitel'nosti. Moscow; Moscow State University (1973). (In Russian).

The kinetics of change in the hydroperoxide content of various lipid fractions in the livers of rats irradiated at 1300 R and the functional integrity of the system of oxidative phosphorylation in the mitochondria were studied to evaluate the role of free-radical oxidation of membrane lipids in the pathogenesis of radiation sickness. The concentration of the peroxidation products increased in the various liver phospholipids after irradiation. The increase was most pronounced in the fractions of phosphatidylethanolamine, phosphatidylcholine, and polyglycerophosphatids. The maximum content of lipid peroxides in phosphatidylethanolamine and phosphatidylcholine corresponded (8 hours after irradiation) to the minimum level of oxidative phosphorylation in mitochondria isolated from the liver of the irradiated animals and to the extremely low resistance of the mitochondria to the aging process. (Referativnyi Zh.)

24332 EFFECT OF X IRRADIATION AT SUBLETHAL AND LETHAL DOSES ON PHOSPHATIDE METABOLISM IN THE BRAIN. Timochko, M. F. Visn. Kiiv. Univ., Ser. Biol.; No. 6, 61-65 (1973).

Changes in the content and rate of renewal of phosphorus in phosphatide fractions of rabbit brain tissue after x irradiation at doses producing the most pronounced functional changes were studied. Whole-body irradiation of the animals at sublethal (400 R) and lethal (1500 R) doses disrupted phosphatide metabolism in a phasic manner, specifically, transient intensification of metabolism in the first few minutes was followed by a phase of inhibition of choline- and ethanolaminephosphatide metabolism. These changes after sublethal irradiation were reversed within 3 weeks, but after lethal irradiation the disturbance of phosphatide metabolism deepened. (Referativnyi Zh.)

24333 EFFECT OF CARBOCHROMEN ON THE ADAPTATION TO HYPOXIC HYPOXIA IN RATS EXPOSED TO GAMMA RAYS. Gamulin, S.; Popovic, Z.; Diminic, V.; Pavicic, S. Period. Biol.; 74: 21-24(1972). (In Serbo-Croatian).

The effect of carbochromen suppressed reactive polycythaemia and increased reactive hypertrophy of the cardiac muscle in rats exposed to hypoxic condition was enhanced by gamma treatment. It is highly probable that the increase of reactive cardiac hypertrophy is due to the compensation of suppressed polycythaemic response. (Bull. Sci. Sect. A)

24334 STUDIES ON HEMOGLOBIN IN THE DEVELOPING CHICK EMBRYOS IRRADIATED WITH ULTRAVIOLET RADIATION DURING EARLY EMBRYOGENESIS. Lwin, K. Arh. Biol. Nauka (Belgrade); 23: No. 1-2, 9-19(1971).

Analysis of hemoglobin from irradiated developing embryos by alkali-denaturation, spectral and "fingerprinting" analysis, starch gel electrophoresis and amino acid analysis indicated

some changes in the amino acid composition and probably tertiary structure. The observed structural changes might suggest a change, induced by uv-irradiation, either in the structures of cistrons controlling the structures of embryonic and/or adult globin chains or the relative rates of production of different development types of hemoglobin. (Bull. Sci. Sect. A)

24335 INTERVAL BETWEEN LETHAL IRRADIATION AND INJECTION OF BONE MARROW CELLS. Rogan, J.; Silobrcic, V. Period. Biol.; 74: 49-52(1972). (In Serbo-Croatian).

CBA mice were irradiated with 950 R whole-body x-irradiation. 9 groups of 8 mice each received allogeneic (C57BL) bone marrow cells, and the same number of mice received syngeneic bone marrow. Allogeneic marrow saved all the recipients from acute radiation death when injected within the first 48 hours after irradiation. Syngeneic marrow was more effective and prevented early death of all animals injected during the first 5 days after lethal irradiation. No correlation between the time of injection of the allogeneic marrow and the mortality due to secondary disease in CBA recipients was found. (Bull. Sci. Sect. A)

24336 CYTOGENETIC STUDIES OF VIRUS- AND RADIATION-INDUCED LEUKEMIAS IN THE RAT. Nakano, M. (Hiroshima Univ.). Hiroshima Daigaku Genbaku Hoshano Igaku Kenkyusho Nenpo; No. 14, 89-97(Mar 1974). (In Japanese).

Chromosomal analysis of rat leukemias induced either by virus or radiation was carried out. In all cases of thymic lymphoma induced by Gross virus alone or a combination of x-irradiation and inoculation of Gross virus, the cells representing the stemline were normal diploid. The deviation from normal chromosome pattern was a very restricted one. This may suggest that these particular leukemias elicited by either procedures are viral in nature. Chromosome pattern in Rauscher virus-induced leukemia was normal in both chromosome number and proportion of the diploid cells. These facts may indicate that virus-induced leukemic cells have no morphologically recognizable marker chromosome under microscopic observation. Granulocytic leukemias induced either by ^{131}I alone or by a combined treatment of ^{131}I and x-irradiation had long latency and low incidence. In all cases but one, the cells representing the stemline were aneuploid with some marker chromosomes. Marker chromosomes of similar morphology have also been observed in spontaneous leukemias. These cytogenetic observations may imply that the neoplastic transformation by the leukemogenic virus involves certain genes of the cell, which do not give the morphological changes of the chromosome, and that the appearance of clone of cells with marker chromosome has no etiological significance but confer the selective advantage for the proliferation of the tumor cell. On the other hand, the consistent presence of the particular marker chromosome in undifferentiated-cell type and granulocytic leukemias developing either spontaneously or induced might be associated with the initial cell transformation, and suggests the similar process in etiology of these cases. (auth)

24337 ENHANCEMENT OF RADIATION EFFECTS BY HEATING OF THE TUMOR. Yerushalmi, A.; Har-Kedar, I. (Weizmann Inst. of Science, Rehovot, Israel). Israel J. Med. Sci.; 10: No. 7, 772-776(Jul 1974).

A therapy technique that allows regional and selective irradiation plus heating of the tumor region is described. An accurate system of continuous monitoring of peritumor, intratumor, and total-body temperature was used on (BALB/C × C57 BL/6)F_1 mice with a well-established transplanted fibrosarcoma tumor in the limb. Four treatment groups were compared: a) control; b) thermic treatment alone (intratumor temperature of 44°C); c) radiation treatment alone (800°R); d) combined thermic and radiation treatment. Irradiation alone resulted in some delay in tumor growth and cure in a few cases. Heat treatment alone resulted in a small delay in tumor growth. Combined heat and radiation treatment resulted in a cure of nearly 90% of the cases. Clear evidence is presented of the increased effectiveness of heat when used together with radiation therapy. (auth)

24338 RESPONSES OF ADULT NEWTS (AMPHIBIA: URODELE) TO X RAYS. Algard, F. T.; Friedmann, G. B.; McCurdy, H. M. (Univ. of Victoria, British Columbia). Can. J. Zool.; 52: No. 6, 665-669(Jun 1974).

Adult Taricha granulosa are relatively radioresistant in both their active (summar and spring) and inactive (winter) phases. Animals exposed to doses between 2700 and 3600 rads in their inactive phase died between 80 and 107 days post irradiation. Animals irradiated with similar doses in their active phase died between 40 and 75 days post irradiation. Some observations relating to changes in pigmentation are discussed. (CA)

24339 ASSOCIATION OF VIRUS IN RADIATION AND CHEMICAL LEUKEMOGENESIS IN RATS AND MICE. Yokoro, K.; Imamura, N.; Kajihara, H.; Nakano, M.; Takizawa, S. (Hiroshima Univ.). Bibl. Haematol.; No. 39, 603-616(1973).

A comparative study of chemical and radiation leukemogenesis was carried out in mice and rats. The results obtained from this study indicated that there seems to be a common mechanism for both chemical and radiation leukemogenesis in mice. In both instances, the direct inducer is Gross type virus; and carcinogenic chemicals or radiation merely provide a favorable condition for a sufficient interaction of the virus and its target cells, and the proliferation of antigenically altered leukemic cells most likely through their immunosuppressive effect on the host. On the other hand, the mechanism involving leukemogenesis in rats appears to be different from that in mice. In rats, there has been no evidence for viral implication and the mechanism remains to be determined. (auth)

24340 EFFECT OF SUBLETHAL (500 R) DOSE OF X RAYS ON ERYTHROPOIESIS IN RATS. Paprocka-Slonka, E. (Wojskowy Intstytut Medycyny Lotniczej, Warsaw); Kuratowska, Z. Acta Haematol. Pol.; 4: No. 3, 239-245(1973). (In Polish).

In Wistar rats exposed to a single dose of 500 R of x rays to the whole body the erythropoietic activity of bone marrow and plasma erythropoietin activity were determined at various time intervals after exposure. Using the method of radioactive iron incorporation into red blood cells the authors found inhibition of production of young erythrocytes on the first days after exposure which was most pronounced on the 4th day after exposure. On the 5th day the so-called phase of abortive regeneration appeared. Return of normal values was observed after 14 days, and after 21 days hyperregeneration of the erythrocyte system occurred. The biological test for erythropoietic activity of rat plasma after exposure to radiation showed a decreased activity in the first period after exposure with a normal regenerating trend. In myelograms radiation-induced injury of bone marrow was observed with a gradual increase in its intensity reaching a peak on the 4th day after exposure and followed by a gradual regeneration of hemopoietic tissues. Return of normal values was observed only after 21 days. (auth)

24341 ULTRAVIOLET FLUORESCENCE OF THE MYELOID CELLS OF THE BONE MARROW OF DOGS SUBJECTED TO CHRONIC IRRADIATION. Aleksandrov, S. N.; Safronova, V. G.; Yagunov, A. S. Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 78-79(1974). (In Russian).

Dogs irradiated 2½ years with a dose of 0.34 R/day, like rats in earlier experiments subjected to the acute action of radiation, showed an increased uv fluorescence of myelocytes and metamyelocytes of the first generation. This indicates a transmission of the genetic damage. (tr-auth)

24342 EFFECT OF FUNCTIONAL TESTS ON THE PHAGOCYTIC FUNCTION OF THE BLOOD OF DOGS EXPOSED TO CHRONIC IRRADIATION. Shilov, V. M.; Markelov, B. A.; Pal'mina, S. I. Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 83-85(1974). (In Russian).

The administration of foreign protein to dogs resulted in damage to the compensatory mechanisms. In control animals the phagocytic reaction was strongly activated, while in the irradiated animals it was suppressed. (tr-auth)

24343 DEPENDENCE OF THE RATE OF THE OXIDATION-REDUCTION PROCESSES IN THE BRAIN AND MYOCARDIUM AFTER EXPOSURE TO LOW-DOSES OF IONIZING RADIATION. Tayts, M. Yu.; Vereshchago, G. G.; Nasirov, R. A.; Tsykhun, G. F. Biokhimiya; No. 1, 61-65(1973). (In Russian).

An increase in the activity of brain and heart mitochondrial dehydrogenases in the first few hours and days after low doses of ionizing radiation and changes in the level of Krebs cycle substrates and optical mitochondria are frequently correlated with the corticosterone level. Moreover, the shifts in the oxidation-reduction processes that occur during irradiation of adrenalectomized animals at the same doses show that mechanisms not mediated by the hypothalamus-hypophysis-adrenal system are involved in the reaction to irradiation. (Referativnyi Zh.)

24344 THYMOSIN CORRECTS THE ABNORMAL DNA SYNTHETIC RESPONSE OF NZB MOUSE THYMOCYTES. Dauphinee, M. J. (Veterans Administration Hospital, San Francisco); Talal, N.; Goldstein, A. L.; White, A. Proc. Nat. Acad. Sci. U. S. A.; 71: No. 7, 2637-2641(Jul 1974).

New Zealand Black (NZB) mice develop after 16 weeks of age an autoimmune and lymphoproliferative disease, which is a model for systemic lupus erythematosus and lymphoid malignancy in humans. At this age, the mice manifest a progressive decline in T lymphocyte (thymus-derived lymphocyte) functions and serum thymosin levels. Thymocytes from 8-week old NZB mice exhibit an abnormal DNA synthetic response when transplanted into le-

thally irradiated C57B1/6 recipients. DNA synthesis (measured as the incorporation of radioactively labeled 5-iodo-2'-deoxyuridine) is delayed in onset and still increasing 6 days after cell transfer. By contrast, 2-week old NZB thymocytes show a normal response which is rapid in onset and completed by day 6. NZB mice were injected with thymosin fraction 5 or with bovine serum albumin starting at 2 weeks of age. Thymocytes from 8-week old thymosin-treated mice showed a normal DNA synthetic response, whereas the albumin-treated controls showed the abnormal response expected at this age. The ability of thymosin to correct the DNA synthetic response was related to dose and duration of treatment. These results suggest that thymosin can induce a more normal state of thymocyte differentiation in NZB mice. If abnormal thymocyte differentiation is related to the subsequent emergence of autoimmunity and lymphoid malignancy, then continuous treatment with thymosin may have therapeutic potential. These experiments suggest that an endocrine disturbance may contribute to autoimmune and lymphoproliferative disease in NZB mice and possibly in humans. (auth)

Invertebrates

24345 (IAEA-R-541-F) DEVELOPMENT OF ARTIFICIAL FEEDING AND MASS REARING OF THE TSETSE FLY, GLOSSINA MORSITANS AND G. SUB-MORSITANS. Part of a Coordinated Programme in the Control of Animal Insect Pests by the Sterile-Male Technique. Final Report, 15 August 1967–30 September 1972. Fraga de Azevedo, J. (International Atomic Energy Agency, Vienna (Austria)). Jan 1973. 10p. INIS.

Best results were obtained with the following media and membranes: Fibrin membrane. Defibrinated blood of pig plus enzymatic solution of Nutrizim, with which was attained a second generation of flies with sizes whose correspondence to their pupal weight was equal to the one reported in the colony flies. The pupal weights were average. Agar membrane. Defibrinated blood of bovines plus N.S.Sol. plus A.T.P. A second generation was obtained, though non-viable for a third one. Maximum longevity obtained was 80 days for females and 64 days for males; average longevity was approximately 30 days. Pathogenic bacteria were isolated from blood fed to tsetse flies; these bacteria were sensitive to tetracycline. (INIS)

24346 (IAEA-R-612-F) HAEMAL AND ENVIRONMENTAL FACTORS REGULATING TSETSE-FLY FEEDING ACTIVITY. Part of a Coordinated Programme in the Control of Animal Insect Pests by the Sterile-Male Technique. Final Report, 1 April 1968–30 September 1972. Odhiambo, T. R. (International Atomic Energy Agency, Vienna (Austria)). Dec 1973. 14p. INIS.

A number of basic experiments were conducted to better understand the feeding activity of adult tsetse fly, including G. pallidipes, G. morsitans, G. austeni and G. brevipalpis. A membrane of bat wings was developed for salivation studies. Various host animals were utilized during these experiments. Mature male and virgin female guinea pigs were the best hosts for G. pallidipes. Infant guinea pigs were very poor hosts. A morphological study of the salivary glands of adult tsetse flies showed there were five morphologically distinct areas. These were determined by light and electron microscopy as well as histological techniques. The digestive process in adult tsetse flies was investigated. Various unidentified protein products were determined at time intervals after feeding. The results of studies of salivation demonstrated that this process did not occur until after the adult fly had pierced the membrane. The saliva of tsetse flies contains an anticoagulant which prevents clotting of the blood during feeding. Removal of the saliva glands did not prevent the flies from feeding, but did result in bloodclots forming in the proboscis channel. The quantity of saliva produced by adult tsetse flies was correlated with the amount of feeding, that is the more saliva produced on a particular day, the higher probability that the adult fly would take a blood meal. Tsetse flies which had not fed for 2 or 3 days salivated more profusely than recently fed flies. Attempts to label saliva with tritium (by injection) or with labelled thymidine were unsuccessful. (auth)

24347 (IAEA-R-752-F) FINE STRUCTURE ANALYSIS OF INDUCED FORWARD AND BACK-MUTATIONS IN DROSOPHILA MELANOGASTER. Part of a Coordinated Programme on the Mechanisms of Radiosensitivity and Repair. Final Report, 1 April 1969–30 April 1971. Falk, R. (International Atomic Energy Agency, Vienna (Austria)). Jan 1973. vp. INIS.

The programmes on the protection of man against radiation and other detrimental factors in the environment rely on the development of the suitable biological indicators for man, using the assay of induced chromosomal aberrations as the criterion for damage. The research contract project has been designed to obtain information on the role of structural and conformational organizations of the chromosome within a cell with regard to its radiosensitivity and genetic damage. Drosophila melanogaster X-chromosomes of contrasting configurations (viz ring versus rod shape) and the relative distribution of the radiation-induced damage in the en-chromatic versus hetero-chromatic regions of the X-chromosome (e.g. occurrence of hot spots for the damage induction) were the major emphasis in this investigation. The results indicated that the ring shaped X-chromosomes irradiated with doses ranging from 1000 rads to 4000 rads yielded as much as six to fifty times more fragments compared to their corresponding rod X-chromosome counterparts at corresponding dose levels. Furthermore the data indicated a distinct "non-random" distribution of break-points along the chromosomal length. The recovered fragments primarily originated through the induced breaks at the junction of en- and hetero-chromatic or in the hetero-chromatic regions of the chromosome. In conclusion the data show that the genetically almost identical X-chromosomes differing only in the geometric configurations within the cells differ strikingly with regard to their radiation responses. In other words, besides the already known radiobiology information, the ultimate radiation-responses of the organism cells bring forth even greater numbers of subtle intracellular interactions which need to be elucidated to enhance the accuracy of exposed-dose estimations. (INIS)

24348 (IAEA-R-758-F) MASS REARING METHODS FOR THE IMPORTANT LEPIDOPTEROUS PESTS OF SOUTH EAST ASIA. Part of a Coordinated Programme on Rice Insect Control and Eradication. Final Report, 1 Jul 1969–30 June 1973. Hormchong, T. (International Atomic Energy Agency, Vienna (Austria)). Sep 1973. 5p. INIS.

The main objective of the project was to develop an inexpensive artificial diet on which rice stem borers could complete their development. This was done to fulfill one of the major requirements for the development of rice stem borer control by the sterile insect technique. A wheat germ/casein medium was devised in which Chilo suppressalis, Chilotraea polychrysa and Sesamia inferens could be bred but not Tryporyza. On this diet, C. suppressalis individually or collectively bred could be produced for 18 sequential generations without deterioration. The pupal return in the individual rearings was consistently higher than in the collective rearings. To decrease production costs, some of the imported nutrients were replaced by cheaper, locally available materials. Replacing wheat germ by preparations of either Wolffia Arhyza (Lemnaceae) or a local soy bean protein ("Kaset") greatly increased the pupal yield of C. suppressalis. However, this insect did not pupate when wheat germ was replaced by either duct wheat or mung bean. A local proprietary vitamin preparation ("Panvitan") substituted in the wheat germ diet for the imported vitamin mixture was just as effective for the development of C. suppressalis. The yield and weight of C. suppressalis pupae reared in wheat germ diet containing various levels of propionic acid decreased as the amount of mould inhibitor rose above 1.0 ml/1,000 g diet. (INIS)

24349 (IAEA-R-811-F) STUDIES ON THE USE OF CYTOGENETIC STERILITY TO CONTROL ONION FLY HYLEMYA ANTIQUA (MEIG.). Part of a Coordinated Programme on Fruit-Fly Eradication or Control by the Sterile-Male Technique. Final Report, 1 December 1969–30 December 1972. Sybenga, H. (International Atomic Energy Agency, Vienna (Austria)). Dec 1972. 3p. INIS.

Because of the considerable economic importance of the onion fly, Hylemya antiqua (Meigen), and the decreasing effectiveness of its chemical control, semi-sterility induced in this pest by translocation was investigated. Semi-sterile stocks were produced by low dose x irradiation (1 krad). By incubating eggs for 3 days at 29°C and at high R. H., it became possible to discriminate between brown eggs (late embryonic lethals), full white eggs (non-fertilized eggs or early embryonic lethals), and empty eggs (hatched larvae). Using brown-egg percentage as a criterion, matings between translocation heterozygotes could be detected. Intercrossing their progenies yielded fertile combinations of homozygotes that could cytologically be distinguished from the normals appearing in the same material. A homozygous stock with an x-autosomal translocation, two additional normal x-chromosomes in the females, and, presumably a single y-chromosome in the males were isolated. It was shown that simple translocations can be induced by low-dose irradiation. By combining analyses of embryo-lethality with chromosome studies, homozygotes could be detected. (INIS)

24350 (IAEA-R-862-F) INACTIVATION OR ATTENUATION OF PROTOZOA BY IONIZING RADIATION, ORIENTED TOWARD THE PREPARATION OF VACCINES. Final Report for the Period 1 January 1970–31 December 1972. Dunjic, A. (Louvain Univ. (Belgium). Inst. du Cancer). Jan 1973. vp. (In French). INIS.

The results on the infectivity and virulence of irradiated T. cruzi inoculated into mice indicate that up to 50,000 R the doses used are inadequate for effective inactivation of the trypanosomes. Taking into account the number of trypanosomes usually inoculated in the immunization experiments, doses of 100,000 and 150,000 R had to be applied. The effective minimum amount of T. cruzi Telahuen injected subcutaneously in mice was 500 trypanosomes per animal. A single vaccination with T. cruzi irradiated with a dose of 100 kR does not protect mice from infection by a virulent strain. More than four inoculations of trypanosomes irradiated at 100 and 150 kR confer partial immunization. Immunized mice have no resistance to reinfection on the 285th day, although no mortality was observed. As regards revaccination, precautions should be taken in respect of storage of the trypanosomes at 4°C for more than 24 hours as from the time of irradiation, since the possibility of restoration has been demonstrated. Inoculation of a non-pathogenic strain of T. gambiense into mice causes a slight delay in parasitaemia, in comparison with that observed in non-vaccinated controls, but confers no protection. In immunized mice, the presence of a small number of agglutinating antibodies was established by the immuno-diffusion method. In hamsters, the experiments did not yield results of interest because of the low sensitivity of this species to T. cruzi. No protection against reinfection was observed in guinea-pigs inoculated with irradiation T. cruzi. Temporary changes in the endocytosis potential were demonstrated by electron microscopy in irradiated T. cruzi and C. luciliae. (INIS)

24351 (IAEA-R-985-F) IRRADIATION OF THEILERIA PARVA, THE CAUSATIVE ORGANISM OF EAST COAST FEVER OF CATTLE, IN ITS TICK VECTOR. Final Report, 1 January 1971–31 December 1972. Purnell, R. E.; Brown, C. G. D.; Burridge, M. J.; Cunningham, M. P.; Emu, H.; Irvin, A. D.; Ledger, M. A.; Njuguna, L. M.; Payne, R. C.; Radley, D. E. (International Atomic Energy Agency, Vienna (Austria)). May 1973. 22p. INIS.

The effects of different doses of irradiation from a ^{60}Co source on the morphology of parasites (Theileria parva) present in irradiated engorged and nymphal ticks (Rhipicephalus appendiculatus) and on the infectivity of the parasites in Bos taurus type cattle was studied. As the irradiation dose increased, the number of parasites killed in the salivary glands of unfed ticks increased, and there was some indication that the development of the parasites in the ticks' salivary gland was delayed. Increasing doses of irradiation resulted in an increased destruction of parasites in infected acini and at high dose levels (45 and 50 krad) the acini contained a mass of destroyed parasites and only a few identifiable infective particles. The results of the inoculation of cattle with suspensions from irradiated ticks, paralleled these findings. A situation could not be produced where a uniformly attenuated suspension of parasites was obtained although a dose of 20 krad gave some evidence of being an attenuating dose. However, it was concluded that the margin of safety about this dose rate was too narrow and its effects too variable for it to be considered for use as a practical control measure. (INIS)

24352 (IAEA-R-1070-F) CONTROL OF THE FALL WEBWORM (HYPHANTRIA CUNEA DRURY) BY GAMMA STERILIZATION OF MALES. Final Report for the Period 1 December 1971–30 November 1973. Beratlief, C. (International Atomic Energy Agency, Vienna (Austria)). Dec 1973. 13p. INIS.

Hyphantria cunea Drury was reared on artificial diets; however further diet improvements are needed. A phagostimulating ingredient such as mulberry leaf powder may be important for larval acceptance of the diet. The larval acceptance and the percentage of the larvae reaching maturity decreased as the number of larvae per 720 ml glass jar increased from 25 to 100. Only 20.1% of the eggs hatched from matings of males treated as pupae with 15 Krad of gamma radiation and untreated females. None of the larvae reached maturity. When the treatment was reduced to 7.5 Krad, some larvae did reach maturity, but there were indications of F_1 sterility. Sexual competitiveness of males treated as pupae with 45 Krad of gamma radiation was reduced by 35%. Male adults treated with 45 Krad suffered ultrastructural changes in the testes consisting of modifications of structure of stermatids and spermatozoids. H. cunea has two generations per year, the first from 28 April to 30 May and the second from 13 July to 26 August. The pupae have very few natural parasites during either generation. H. cunea larvae developed on all nine hosts tested, but the largest insects were produced on mulberry. (auth)

24353 (IAEA-R-1204-F) FIELD PERFORMANCE OF RELEASED NORMAL AND RADIATION-STERILIZED OLIVE FRUIT FLIES IN A GROVE IN NORTHERN GREECE. Part of a Co-ordinated Programme on the Control of Eradication of Fruit Flies by the Sterile-Male Technique. Final Report, 15 July 1972–14 July 1973. Tzanakakis, M. (International Atomic Energy Agency, Vienna (Austria)). Nov 1973. 4p. INIS.

No data being available on the levels of the adult population in the groves selected, a network of McPhail traps baited with a 3% mixture of amino-acids in water (Rhodia protein) was maintained in these groves and serviced during July 1972 to July 1973. The seasonal fluctuations in the native adult population; its sex ratio; the sexual maturity of the females; and the percent females inseminated were determined. Adult olive flies were found to be present throughout the year in or at least near the groves examined. The general trend of the adult population was to increase in April, subside during early summer, reach a seasonal peak in September to October and then subside again. The proportion of females with mature eggs and those inseminated increased from March to May and suddenly dropped in November following changes in temperature. In the area under consideration, this low native population during winter and until early summer with increasing sexual maturity and mating from March to May will determine in part the timing of sterile olive fly releases. (INIS)

24354 MANGO WEEVIL: COBALT-60 γ IRRADIATION OF PACKAGED MANGOES. Seo, S. T.; Kobayashi, R. M.; Chambers, D. L.; Steiner, L. F.; Lee, C. Y. L.; Komura, M. (Agricultural Research Services, Honolulu, Hawaii). J. Econ. Entomol.; 67: No. 4, 504-505(Aug 1974).

Minimum doses of 20.6 and 32.9 krad of cobalt-60 S-radiation eliminated ca. 1200 eggs, larvae, pupae, and adults of Cryptorhynchus mangiferae (F.) from mangoes, Mangifera indica L., in corrugated fiberboard cartons with absorber thicknesses of 2.56 and 4.27 g/cm^2, respectively. Since the opposite sides of each carton were irradiated, the absorber thickness was the product of the density of the carton and the mid-distance from the irradiated sides of the carton (6.5 cm for A-type and 8.0 cm for B-type. Also, the few irradiated adults that were found alive 6 months after treatment with 20.6 krad at absorber thicknesses of 3.20 and 3.97 g/cm^2 were sterile and shortlived. Longevity of irradiated adults decreased inversely logarithmically with the dose, so the expected mean longevities were ca. 3.5 and 2.2 months for doses of 20.6 and 32.9 krad, respectively. (auth)

24355 EFFECT OF NITROGEN ON THE COMPETITIVENESS OF IRRADIATED MUSCA DOMESTICA. LaChance, L. E.; Richard, R. D. (Agricultural Research Services, Fargo, ND). J. Econ. Entomol.; 67: No. 4, 562-563(Aug 1974).

Male house flies were placed in plastic vials for gamma irradiation in nitrogen. Fertility and competitiveness were determined by placing irradiated and normal males in cages with normal females. Results indicated that males irradiated in nitrogen were nearly 3 times as competitive as those irradiated in air. (HLW)

24356 CHROMOSOMAL BASIS OF DOSAGE COMPENSATION IN DROSOPHILA. VI. Transcription and Replication in Male X-Chromosome of D. Melanogaster After X Irradiation. Lakhotia, S. C.; Mukherjee, A. S. (Univ. of Calcutta). Nucleus (Calcutta); 15: No. 3, 189-200(Dec 1972).

Replicative and transcriptive activities of the polytene X-chromosome of male Drosophila melanogaster have been examined autoradiographically after x-irradiation (1 kr) of late third instar larvae. There is a selective reduction in the relative rate of ^3H-uridine uptake by the male X 3-4h after the treatment. ^3H-thymidine labelling patterns were examined 1-2h, 2-4h and 6-7h after 1 kr, and the results were interpreted to show relatively greater reduction in the rate of DNA synthesis by the male X compared to the 2R. Due to this the normally faster replicating male X exhibits various alterations in its replicative organization which are manifested in a high frequency of "exceptional" patterns and relatively higher labelling frequency of several X-chromosomal sites in irradiated nuclei compared to normal male nuclei. The results suggest that the single X-chromosome in male is normally primed to do "extra" work to equalize its activity to that of the two X's of female and that this hyperactivation of the male X in D. melanogaster is reversible under circumstances which inhibit chromosomal activity. (auth)

24357 RADIATION INDUCED SEMI-STERILITY FOR GENETIC CONTROL PURPOSES IN THE ONION FLY HYLEMYA ANITIQUA (MEIGEN). P. 1. Isolation of Semi-Sterile Stocks and Their Cytogenetical Properties. Wijnands-Staeb, K.J.A. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen (Netherlands)); van Heemert, C. (Landbouwhogeschool Wageningen (Netherlands). Lab. voor Erfelijkheidsleer). Theor. Appl. Genet.; 44: No. 3, 111-119(1974).

2 figs.; 3 tabs.; 15 refs.

In the preliminary stages of a study into the use of translocations for genetic control of the onion fly Hylemya antiqua (Meigen), irradiations were carried out in order to obtain chromosomal rearrangements. Several irradiation experiments, with x rays or fast neutrons, were carried out on pupae and adults

of both sexes at substerilizing doses below 3.0 krad, to establish a favorable method of induction. Because no visible markers are available for the genetic screening of induced rearrangements, and the reciprocal translocations or inversions in demand express themselves in the heterozygous condition by reduced fertility, a total of 234 F_1 individuals of both sexes were checked for reduced fertility. 50 F_1 individuals were suspected of carrying a translocation or inversion when they produced an egg hatch of between 30 and 60% (semi-sterility). This category was passed for cytogenetic analysis. In the progeny of 25 suspect F_1 individuals, 9 different rearrangements were established, of which 7 were translocations. This means a yield of 4% for all the tested F_1. After a discussion of the normal karyotype, some of the observed rearrangements are described. Irradiation of males with 1.0 krad of x rays is advised for the production of semi-sterile stocks carrying translocations. Fast neutrons were not found to be better than x rays. At doses higher than 1.0 krad complex rearrangements and/or fragments were observed. A translocation homozygote could be isolated in the case of an X-autosomal translocation, and this stock will be used for further genetic control purposes. (GE)

24358 GAMMA-IRRADIATION OF IMMATURE STAGES OF THE BEETLE DERMESTES FRISCHII KUG. Abdu, R. M. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Radiobiology); Shaumar, N. F. (Ain Shams Univ., Cairo (Egypt). Dept. of Entomology). Z. Angew. Entomol.; 75: No. 1, 103-106(Feb 1974). 3 figs.; 1 tab.; 7 refs.

Newly hatched and last larval instar of Dermestes frischii Kug. were exposed to different dose levels of gamma radiation. Larval and pupal periods were increased with increasing radiation dose. At 10 Krad, longevity of larval period was 31.18 ± 0.98 and for pupal stage 9.54 ± 0.68 days, while for the control the longevity was 16.71 ± 1.41 and 5.02 ± 1.40 days, respectively. Longevity of pupal stage produced from irradiated last larval instar was more than that produced from first larval instar. The reduction of the longevity of adult produced from irradiated immature stages was also increased with the increase of dose level. (auth)

24359 RADIORESISTANCE OF SOME PLANKTON AND BENTHOS SPECIES OF CRUSTACEA. Dolgushina, Z. K.; Onanko, Yu. I. pp 50-56 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Results of experimental studies on the effects of the treatment of some species of plankton and benthic crustaceans with ionizing radiation in the range from 0.2 to 12 kR are presented. A rather high radioresistance of these organisms has been ascertained. Crustaceans belonging to different orders and even to the same family show different radiosensitiveness. For some crustaceans a dose was found that stimulates the female fecundity. (auth)

24360 STUDY OF RADIOSENSITIVITY OF NATURAL POPULATIONS OF FRESHWATER MOLLUSK LYMNAEA STAGNALIS L. Famelis, S. A. pp 89-94 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Developing eggs of freshwater snail Lymnaea stagnalis were used to show that embryos of populations coming from various lakes of the limnological type differ in radiosensitivity. The survival of irradiated embryos in populations coming from a mesodistrophic lake is much lower than in populations coming from an oligomesotrophic lake. Radiosensitivity of embryos was subject to seasonal variations. (auth)

24361 INFLUENCE OF TEMPERATURE ON X-RAY DOSE FRACTIONATION EFFECT IN PIOPHILA CASEI L. Sacchi, L.; Grigolo, A.; Caprotti, M. (Univ., Pavia, Italy). Genet. Agr.; 27: No. 4, 410-414(31 Dec 1973). (In Italian).

Radiobiological experiments were carried out to study the influence of the temperature on repair processes in samples of Piophila casei treated with fractionated doses of x rays. Five day old pupae were given doses of 35,000 R at an interval of 1 or of 6 hours. During the interval, one set of pupae was kept at +5°C and another at +27°C. The results show a decreased pupal mortality in the samples kept at +27°C when the interval between the two doses was 6 hours. The repair processes are probably correlated with the metabolism of the insect, which is temperature dependent. (auth)

24362 PROTEOSYNTHETIC ACTIVITY OF THE PROTHORACIC GLANDS AND ECDYSONE TITRE IN PERMANENT LARVAE OF LOCUSTA MIGRATORIA OBTAINED BY SELECTIVE IRRADIATION OF HEMATOPOIETIC TISSUE. Hoffmann, J. A.; Weins, M. J. (Univ., Strasbourg). Experientia; 30: No. 7, 821-822(15 Jul 1974). (In French).

The prothoracic glands of permanent fifth instar larvae of Locusta migratoria (moulting blocked by selective x-ray treatment of the hemocytopoietic tissue) are in a state of high activity as evidenced by the rate of incorporation of a labelled amino-acid into the proteins synthesized in these glands. Such permanent larvae apparently synthesize no ecdysone nor ecdysterone. (auth)

24363 INHERITANCE OF X-IRRADIATION-INDUCED EFFECTS IN THE RAT TAPEWORM, HYMENOLEPIS DIMINUTA. Schiller, E. L. (Johns Hopkins Univ., Baltimore). Contract AT(30-1)-2481. J. Parasitol.; 60: No. 1, 35-46(Feb 1974).

Observations are presented on inheritance in Hymenolepis diminuta, based on an analysis of 30 successive generations of sexual progeny reared from an individual parent worm whose germinative region had been exposed to 45 kr of x-irradiation. The experimental design employed involved transection, irradiation, and surgical implantation of scoleces into laboratory rats. Twenty-eight different testicular patterns in these worms were examined. Comparative analyses of their overall variation frequencies indicate that not only were the effects of the initial radiation transmitted to the progeny, but these effects were found to be cumulative. Data on frequency of occurrence and distribution of each of the different testicular patterns investigated suggest that they vary independently of each other. Employment of other experimental designs described provided evidence that the irregular fluctuations and progressively increasing frequencies with which the variants occurred in successive progeny were due to random genetic recombinations within generations as a result of interstrobilar fertilization in multiple infections. The additive effects of a second treatment with 45 kr of x-irradiation 9 generations after the initial exposure also clearly indicated an hereditary continuity of the irradiation-induced injuries. It is suggested that exposure to ionizing radiation may produce heritable defects in radiosensitive "stem cells" of the germinative region. Such defects could be perpetuated by the mechanism of gene-linked inheritance. (auth)

24364 BABESIA BIGEMINA: IMMUNE RESPONSE OF CATTLE INOCULATED WITH IRRADIATED PARASITES. Bishop, J. P.; Adams, L. G. (Texas A and M Univ., College Station). Exp. Parasitol.; 35: 35-43(Feb 1974).

Effects of various radiation dosages on the infectivity and immunogenicity of Babesia bigemina were studied. Calves infected with 1×10^{10} B. bigemina parasitized erythrocytes exposed to 24 krad developed progressive parasitemias. Some calves receiving 1×10^{10} parasitized erythrocytes irradiated at 36 krad did not develop progressive infections. Progressive infections were prevented by exposure to irradiation at 48 and 60 krad. A degree of acquired resistance to infection with B. bigemina developed in calves after inoculation with parasites irradiated at 48 and 60 krad. The resistance developed was sufficient to suppress multiplication of the Babesia and to permit calves to survive otherwise severe clinical infections due to challenge with nonirradiated parasites. Irradiated parasites were frozen without apparent loss of immunizing properties. (auth)

24365 BABESIA RODHAINI: EFFECTS OF THE IMMUNE SYSTEM IN MICE. Roberts, J. A.; Tracey-Patte, P. (CSIRO, Queensland, Australia). Exp. Parasitol.; 35: 119-124(Feb 1974).

Possible functions of antibody in controlling multiplication of B. rodhaini in mice have been investigated. The infectivity of parasites which have been circulating in the blood of immune hosts for 4 hr is not impaired. Clearance of parasitized red cells from the blood of immune hosts is not impaired if the parasites are prevented from leaving the red cells by the effects of radiation damage. The rate of clearance of parasitized red cells by immune hosts is very slow compared with the clearance of foreign red cells by normal hosts. (auth)

Radionuclide Effects (Internal Source)

Refer also to abstracts 23979, 24238, 24611–24616, and 26197.

24366 GENETIC RADIATION DAMAGE. Parker, D. R. (Univ. of California, Riverside). pp 494-510 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

The nature of genetic material, ways it can be altered, and genetic damage from radiation are considered. Topics covered include: mutation rates in male and female germ cells, average mutation rate, chromosomal aberration, numerical aberrations, chromosomal rearrangements, estimation of risk, genetic death, doubling dose, incidence of genetic disease, mutation vs genetic polymorphism, multifactorial diseases, and chromosomal diseases. (MCG)

Man

Refer also to abstracts 23975, 24247, 24259, 24275, 24381, 24383, 24386, and 24389.

24367 (COO-1784-30) STUDY OF THE PHYSIOLOGICAL FUNCTION AND HISTOLOGICAL CHANGES OF THYROIDS IRRADIATED WITH RADIOACTIVE IODINE. Progress Report, October 1, 1973–September 30, 1974. Dobyns, B. M. (Case Western Reserve Univ., Cleveland, Ohio (USA)). 30 Jun 1974. Contract AT(11-1)-1784. 18p. Dep. NTIS $4.00.

Progress is reported on the following research projects: effects of ^{131}I radiation on the function of the thyroid in clinical subjects with hyperthyroidism; kinetics of therapeutic doses of ^{131}I in clinical subjects; basic considerations of neoplasm formation in animals and man; experimental production of thyroid neoplasms with ^{131}I in the rat; methods by which neoplasms develop in the rat thyroid following ^{131}I; radiation effects in the Marshallese accidentally exposed to fallout; radiation effects on the thyroid of children in Utah; experiments on genetic effects in rats; behavior of some rapidly growing thyroid neoplasms produced by ^{131}I; and life span of the normal and irradiated thyroid cell. (HLW)

24368 (IAEA-R-791-F) CHROMOSOME ABERRATIONS IN THE PERIPHERAL BLOOD LYMPHOCYTES OF PEOPLE LIVING OR WORKING IN AREAS OF HIGH ATMOSPHERIC CONCENTRATION OF NATURAL RADON-222 AND ITS DAUGHTERS IN BADGASTEIN, AUSTRIA. Final Report, 1 September 1969–30 September 1972. Pohl-Rueling, J. (International Atomic Energy Agency, Vienna (Austria)). Dec 1973. 7p. INIS.

To obtain significant mean values of the air activity, the contents of Rn-222, Rn-220, Pb-214, Pb-212 and the ratios of Rn-222 : Po-218 : Pb-214 : Bi-212 were measured. The data demonstrate a dependency on age and sex for the analyzed aberrations. To establish a dose-response curve an attempt was made to normalize the findings with regard to age. A dependence between internal dose due to the inhalation of Rn 222 and its daughters, and chromosomal aberrations in peripheral blood lymphocytes has been demonstrated in a population living and working within a region of elevated natural radioactivity. Chromosome aberrations and aneuploidy increase at alpha blood doses higher than 0.3 rem/year, corresponding, according to our calculations, to a continuous inhalation of air with a radon-222 content of 40 pCi and an average decay product ratio, and is commensurate with the maximum permissible dose values. This investigation suggests that a threshold for visible morphological signs of radiation damage in the chromosomes of man exists. (INIS)

24369 (NRPB-R-21) ASSESSMENT OF CONTAMINATION FROM THE RELEASE OF ACTIVATED SULPHUR HEXAFLUORIDE FROM A Q-TUBE NEUTRON GENERATOR USED FOR RADIOTHERAPY. Rowlands, R. P.; Humphries, D. L. O. (National Radiological Protection Board, Harwell (UK)). Apr 1974. 17p.

Neutron activation of the sulfur hexafluoride insulating gas within the canister housing a neutron generator will produce the nuclides ^{32}P, ^{18}F, and ^{35}S. The gas is at a pressure of 414 kPa gauge. A safety assessment indicates that a sudden leakage could lead to internal radiation dose commitments to exposed persons of 220 mrem to bone from ^{32}P, 15 mrem to lung and GI (ULI) from ^{18}F, and 0.052 mrem to lung from ^{35}S, assuming no depletion of activity from the gas. In practice, adsorption of activity on surfaces within the canister would be expected. When gas was released experimentally after the Q-tube had been in continuous operation for 25 hr, only small amounts of ^{32}P, ^{18}F and ^{13}N (from nitrogen impurity in SF_6) were found. The above dose commitments can therefore be regarded as upper limits. A continuous leakage small enough not to operate the safety interlock within the Q-tube's useful life would result in doses much lower than those arising from a sudden release. The radiological hazard from released gas is therefore minimal. (auth)

24370 LATE UROLOGICAL DAMAGE IN THE CASE OF THOROTRAST PERIVASCULAR DEPOSITS IN THE INGUINAL REGION. Kaick, G. van; Oeftering, T.; Wenz, W. (Deutsches Krebsforschungszentrum, Heidelberg). Radiologe; 14: No. 4, 182-185(Apr 1974). (In German).

In 47 cases of a group of 550 examined Thorotrast patients, Thorotrast was used for angiography of the femoral artery. In 21 of these patients, paravascular deposits in the inguinal region were found. The case history of four patients is given in whom the paravascular deposits extended suprainguinally along the pelvic vessels up to the upper sacral vertebrae. Due to the envelope formed by the paravascular deposits around the ureter at the place where it enters the small pelvis, these Thorotrast granulomas caused aggravating ureter compressions after latency periods of 15, 27, 29 and 30 years, followed by hydronephrosis; in three of the four patients, occlusion of the pelvic vein in the vicinity of the paravascular deposit was observed. In spite of the long latency periods, a causal relationship between the paravascular Thorotrast deposits and these pathological changes is obvious. This has to be taken into account in assessing the pension to be granted to these patients as being war disabled. (GE)

24371 THYROID FUNCTION IN PATIENTS TREATED WITH RADIOACTIVE IODINE. Tunbridge, W. M. G.; Harsoulis, P.; Goolden, A. W. G. (Hammersmith Hospital, London). Brit. Med. J.; 3: No. 5923, 89-92(13 Jul 1974).

A series of 105 patients treated at least two years earlier with radioactive iodine for thyrotoxicosis have been surveyed. Eighty-five patients (81%) were euthyroid clinically and on the basis of routine thyroid function tests. Of the euthyroid patients 46 (54%) had normal thyroid-stimulating hormone (TSH) levels and 39 (46%) had raised TSH levels. There was no difference in serum triiodothyronine levels between these two groups but the serum protein-bound iodine and serum thyroxine, though still well within the normal range, were significantly lower in the group with raised TSH levels. The serum cholesterol was also significantly higher in this latter group. Most of the euthyroid patients were seen again a year later. None had become hypothyroid and neither those with normal nor those with raised TSH levels showed any evidence of a decline in the level of serum thyroxine. It is concluded that raised serum TSH levels in patients treated with iodine-131 are not necessarily indicative of hypothyroidism. There is no indication that patients who have this abnormality become overtly hypothyroid over a 12-month follow up. (auth)

24372 HUMAN RADIATION EXPOSURES FROM NUCLEAR POWER: THEIR MAGNITUDE AND SIGNIFICANCE. Sagan, L. A. (Dept. of Environmental Medicine, Palo Alto, CA). pp 480-493 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

Potential human effects from radiation exposure as well as levels of exposure encountered in the vicinity of operating nuclear power plants are considered. Carcinogenesis, human leukemia, and longevity are discussed in relation to biological radiation effects. Genetic effects of radiation are also considered. The threshold and linear hypotheses of effects are considered. Exposure to radiation from drinking water, consumption of fish caught from rivers, and gaseous wastes is discussed. (MCG)

Animals

Refer also to abstracts 24246, 24298, 24396, and 24397.

24373 (IAEA-R-646-F) RADON AND SiO_2 TOXICITY ON RATS' LUNGS. Final Report, 1 November 1968–31 November 1972. Panov, D. (International Atomic Energy Agency, Vienna (Austria)). May 1973. 41p. INIS.

The synergistic effect of radon and its decay products and SiO_2 on rats' lungs was studied. Rats were examined and sacrificed after a short term exposure of 3 months and after a long term exposure of 9 and 18 months. Male rats of Wistar race, 2.5–3 months old, of average body weight around 190 g were used for this investigation. The rats were divided into four sub-groups: for radon inhalation, for quartz dust inhalation, for radon and quartz dust inhalation, and control sub-group. Three months exposure showed only slight hypochromic anaemia, some changes in coagulation, and enlargement of the lymph nodes of the mediastinum. Rats were exposed to concentrations of 10^{-7} Ci to the litre and to quartz dust from 50–70 mg/m^3. After 9 months there was no statistical significant change in the lungs of the exposed animals as compared to the controlled group. However, ^{210}Po concentration in the kidneys of the exposed group was 5 times higher but there was no pathological changes in the kidney. After 18 months exposure it was found that the mean values of the number of red blood corpuscles was lower than those animals killed after 9 months. Similarly the white cells were significantly lower in the radon quartz group. Radon and silicon inhalation did not influence the blood coagulation process. Also the ^{210}Po content in the kidneys and lungs were higher after 18 months exposure. The lung texture showed hyperaemia exudation and infiltration of the interstitium in the rats' lungs. In the lungs dusted with quartz radon inhalation influences the course of a large number of silicotic nodules. No malignant changes were found in the experiment. (INIS)

24374 CHRONIC EFFECT OF ^{144}Ce AND ^{137}Cs RADIOISOTOPES ON EMBRYONIC DEVELOPMENT OF THE ATLANTIC SALMON. Kasatkina, S. V.; Kosheleva, V. V.; Migalovskaya, V. N.; Migalovskii, I. P.; Oganesyan, S. A. pp 25-35 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Effects of ^{144}Ce and ^{137}Cs, characterized by three levels of activity, on the embryonic development of Atlantic salmon, its peripheral red blood, hypophysis, thyroid gland, hatching gland, early hematogenesis, mitotic activity, and chromosome aberrations were investigated. Increase of mitotic activity was detected at the stage of blastomere blastula, as affected by ^{144}Ce, and decrease of mitotic activity, as affected by ^{137}Cs. Interrelation between frequency of aberrant mitoses and the number of particles passing through the embryo was determined. Mortality rate of embryos was higher when affected by ^{144}Ce than by ^{137}Cs. Possible interrelation between the dynamics of hatching enzyme accumulation and erythropoiesis is indicated. Under the influence of radionuclides the amount of aberrant mitoses increases in the red blood cells. Cerium-144 causes formation of a greater number of abnormal embryos than ^{137}Cs. The amount of primitive sex cells in embryos and larvae affected by radionuclides is greater than that of the controls. In the thyroid gland there appear destructive changes and hormone extraction is blocked; there is less neurosecretory matter in the neurohypophysis of the embryos and larvae under test than of the control ones. (auth)

24375 RADIORESISTANCE OF EGGS OF SOME INDUSTRIAL FISH. Telysheva, I. G.; Shulyakovskii, Yu. A. pp 78-88 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Experimental data concerning the effect of the solutions of long-lived radionuclides on the development of eggs of some Atlantic fishes are presented. It is shown that the concentrations of long-lived radionuclides of about 10^{-6} to 10^{-5} Ci/l^{-1} creating in the developing organisms doses below 100 rads do not exert a pathogenic influence on the development of eggs of the investigated species. (auth)

Plants

24376 EXPERIMENTAL STUDY OF INJURING EFFECT OF A MIXTURE OF FISSION-PRODUCT RADIONUCLIDES ON THE EMBRYONIC DEVELOPMENT OF FRESH-WATER FISHES ACCORDING TO THE DOSE RECEIVED. Mashneva, N. I.; Sukal'skaya, S. Ya. pp 45-49 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

To characterize the injuring effect of a single contamination of water with a mixture of uranium fission products and some separate radionuclides in concentrations 3.10^{-9} to 3.10^{-3} Ci/l on the developing embryos some integral indices were studied. Results of the experiment indicate that mortality of peeled eggs of Coregonus peeled, which received a dose of more than 500 rad, was fixed on a late stage of embryonic development, at the beginning of hatching of larvae. For some indices (decrease of average lifetime, shortening of the period of embryo's development, and increase of incidence of embryo's abnormality) the dependence of the power-function type on dose (within the limits 100 to 30,000 rad) absorbed during the course of incubation of eggs of Coregonus peeled was established. (auth)

24377 EFFECT OF FISSION PRODUCTS OF ^{235}U ON THE MUTATION PROCESS IN CHLORELLA CULTURES. Shevchenko, V. A.; Alekseenok, A. Ya.; Prister, B. S.; Ryabov, G. G. pp 102-108 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Data are given on mutation dynamics in asynchronous cultures of Chlorella vulgaris during continuous exposure to radionuclides mixtures that imitated 14-, 50- and 480-hour-old fission products of ^{235}U. In the first stage of the experiments, an increase was observed in the number of mutant cells in the cultures exposed in the exponential growth phase to the various dose rates. With the decrease of radiation dose to the end of the experiments when dose rate caused by long-lived radionuclides remained in the mixture was close to constant, the number of mutants in irradiated populations was maintained on the level stipulated with the dose of irradiation. (auth)

Microorganisms

24378 SURVIVAL AND GAS FORMATION OF DENITRIFICANS BACILLI IN THE PRESENCE OF RADIOACTIVE AGENTS IN WATER MEDIUM. Zhogova, V. M. pp 57-61 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The high concentrations of ^{90}Sr (4.0×10^{-3} Ci/l) and ^{210}Po (1.0×10^{-4} Ci/l) in water medium slightly prevented the development of denitrificans bacilli as compared to controls, but did not strongly prevent their accumulation. The presence of these isotopes in growing cultures in concentrations 1.6×10^{-10} to 1.6×10^{-4} Ci/l exerts neither depressing nor stimulating influence on the process of gas formation. (auth)

24379 GENETIC EFFECTS OF ^{35}S DECAY IN CELLS OF YEAST SACCHAROMYCES CEREVISIAE. I. Lethal Effect of ^{35}S Decay Incorporated in Cells of Different Ploidy and Radiosensitivity. Gracheva, L. M.; Korolev, V. G. (Leningrad Inst. of Nuclear Physics). Genetika; 10: No. 6, 70-77(Jun 1974). (In Russian).

The lethal effect of ^{35}S decay on cells of yeast Saccharomyces cerevisiae of different ploidy was studied. The efficiency of incorporated ^{35}S is practically equal to the efficiency of incorporated ^{32}P and it is 10 times higher than external β-radiation. Triploid and tetraploid have the same radioresistance but the diploid has a slightly higher sensitivity. They are more radioresistant than the haploid. The diploid xrs_2 is less radioresistant than the wild type diploid but it is more radioresistant than the haploid. The sensitivity to ^{35}S decay structure in cells of eukaryotes is discussed. (auth)

Nuclide Kinetics and Toxicology

Refer also to abstracts 23979, 23998, and 26195.

24380 KINETICS OF EXCHANGE OF GASEOUS TRITIUM. Zhuravlev, V. F.; Kalyazina, N. S. Gig. Sanit.; No. 6, 113-114 (Jun 1974). (In Russian).

It was shown that gaseous tritium is very rapidly eliminated from the organism. It was partially oxidized in the organism to tritium oxide. The quantity of tritium oxides formed in the oxidation process does not exceed 0.5% of all the tritium exchangeable in the organism during the inoculation process. (tr-auth)

Man

Refer also to abstracts 23999, 24247, 24259, 24275, and 24372.

24381 (KFK-1849) ACTINIDE PROJECT. Annual Report, 1973. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Apr 1974. 242p. (In German). Dep. NTIS (US Sales Only) $15.25.

The Actinide Project on development of use for the actinides consists of two distinct and separate functions: one is biotechniques and radiation medicine and the other is exploration of ore deposits. A literature review was made of ^{239}Pu contamination dangers. In the study of transuranium elements for biomedical purposes emphasis was given to the development of a technology for the preparation of ^{238}Pu from neutron-irradiated ^{241}Am. The results of irradiation of ceramic capsules, and the irradiation behavior of ^{241}Am and ^{237}Np were reported. Chemical methods for the preparation of biomedically pure ^{238}Pu from irradiated ^{241}Am were investigated. The development of ^{238}Pu capsules for pacemakers, neutron emission measurements from these pacemakers, and in-phantom dosimetry with them were reported. Preliminary studies were begun on the use of ^{252}Cf as a neutron source for in vivo activations. The first field test of a neutron borehole probe were made. The measurement accuracy attainable for activation measurements in boreholes was examined in greater detail. An improved research probe with on-line data processing was developed. The continued development of the x-ray fluorescence analysis for borehole probes was described. The chemical scheme used for the analysis of borehole cores was outlined. In the study of surface deposits the development of a Mn analysis system was expanded. The essential conditions for the design of a field instrument were studied with neutron and γ transport calculations. The total electronic system, the sampling system, and the device itself and its major components were discussed. The principles for the on-line activation analysis with ^{252}Cf were developed. The software and hardware for the data processing system were tested. The ^{238}Pu content of irradiated ^{241}Am and commercial ^{238}Pu was determined. A bibliography of 99 references of papers published during the year is appended. (JSR)

24382 (LA-5633-PR, pp 20-33) INDUSTRIAL HYGIENE. May 1974.

In annual report of the Biomedical and Environmental Research Program.

Progress is reported on research studies related to the environment and particularly the working environment. Data are presented

from studies on sampling, characterization, and control of aerosols, and analyses of tissues from autopsies of persons in the general public and those exposed to materials associated with AEC operations. In the aerosol field, a study was made of the collection efficiency of filters operated under intermittent cyclic flow simulating conditions occurring when a filter is used in a respirator. Some preliminary results indicate differences between cyclic flow efficiencies and steady flow efficiencies for certain particle sizes. Another project in this field is a study of agglomeration of particle dispersions used for in-place filter testing. A computer model was developed for assessing the effects of various parameters on air cleaner performance especially in terms of factors of biological and physical significance such as visibility degradation and inhalation risk. Analyses for Pu content were made on autopsy tissues from 60 occupationally exposed persons and several hundred having no occupational exposure to plutonium. The highest Pu concentrations found were in the lymph nodes, with liver, lung, kidney, and bone following in order to decreasing concentration. Reanalysis of gonadal tissue obtained in a limited number of cases revealed concentrations lower than reported previously. A statistical study of lung and liver tissue analyses for plutonium in the general population shows an apparent correlation of liver concentration with age at death. The lung data do not show such correlation. An investigation has been initiated on the use of neutron irradiation of bone sections mounted on thin plastic film to determine the distribution of minute amounts of plutonium in bone and marrow. Some tissue samples were also analyzed for uranium, although the method of analysis is not sensitive enough to detect quantitatively the amounts in samples from persons having no known occupational exposure. (CH)

24383 (PB-229704/2) IMPLICATIONS TO MAN OF IRRADIATION BY INTERNALLY DEPOSITED STRONTIUM-89, STRONTIUM-90, AND CESIUM-137. A Report of an Advisory Committee from the Division of Medical Sciences, National Academy of Sciences–National Research Council, Washington, D. C. (Federal Radiation Council, Washington, D. C. (USA)). Dec 1964. 38p. NTIS $5.00.

All ionizing radiations can cause the same types of biological effects, the probability of any given effect depending on the conditions of exposure. Consequently, the hazards of irradiation from radioactive strontium and cesium, as from any internally deposited radionuclide, depend on the distribution of the elements in the body, their retention, and their radioactive decay. These properties, in turn, depend on the chemical behavior of strontium and cesium in the forms in which they are encountered and on the physical characteristics of their several isotopes. (GRA)

24384 (UR-3490-579) CONCEPTS OF CRITICAL ORGAN AND RADIATION DOSE AS APPLIED TO PLUTONIUM. Stannard, J. N. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1974. 35p. (CONF-740550-1). Dep. NTIS $4.75.

From 2nd annual life sciences symposium on plutonium–health implications for man; Los Alamos, New Mexico, USA (22 May 1974).

The concepts of critical organ or tissue and the calculation of radiation dose are central to the development of standards for most radionuclides. In the case of ^{238}Pu and ^{239}Pu the occupational standard was based on a modification of the direct calculation of maximum permissible annual dose (MPAD) or dose rate, but critical organs must still be chosen for different routes of entry and different compounds and for all of the derived standards. Changes in such standards by likely variations of metabolic parameters and models are shown to be significant but not large. Application of the critical organ concept to population exposure standards poses some new problems because the basic MPAD is the same for all organs. A simple scaling factor from occupational exposure standards is not satisfactory. Use of the concept of dose commitment has many advantages but it is still necessary to select a critical organ and calculate dose. By-passing some of the problems in present practices by using risk estimates seems unlikely for plutonium at the present time because of the paucity of human effects data and the fact that the animal experiments used quite different dosage regimens from the likely exposure situations of humans. A brief comparison is made of radiation and chemical hazard evaluation procedures. (auth)

24385 SKELETAL DOSE ESTIMATION OF THE PATIENT ADMINISTERED YTTERBIUM-169 CITRATE FOR TUMOR DIAGNOSIS. Anzai, I. (Tokyo Univ.); Kanno, M.; Tobari, H.; Higashi, T. Radioisotopes (Tokyo); 23: No. 1, 59-63(Jan 1974). (In Japanese).

Ytterbium-169 citrate has recently been put into medical use for external imaging of tumor tissues. The skeletal absorbed dose received by the patient was estimated in accordance with the MIRD Committee method. A 500 micro-curie intravenous injection resulted in 13 rads in the skeleton, with the most important contribution of the internal conversion electrons emitted in the electron capture decaying process of the nuclide. The contribution of the penetrating radiations originating in other organs was negligibly small. The average total body dose was approximately 2 rads. (auth)

24386 DIAGNOSIS AND THERAPY OF CONTAMINATED WOUNDS. Ohlenschlaeger, L. (Kernforschungszentrum Karlsruhe (F. R. Germany). Medizinische Abt.). KFK Nachr.; 6: No. 1, 26-32(1974). (In German).

8 figs.

Wounds contaminated with radioactive substances call for special diagnostic and therapeutic measures different from those to be applied in the treatment of inhalation or ingestion of radioactive substances. Besides type, extent, and location of the wound, the physical and chemical properties of the radionuclide and its radiotoxicity are of importance for the prognostic evaluation. Determination of the level, type, extent and localization of the wound activity is essential for a successive therapy. This requires a sensitive measuring equipment, and the currently available apparatus is quite satisfactory as far as the determination of the level and extent of the wound activity is concerned. As for the remaining two parameters, however, the current means and methods still need improvement. The detection of alpha emitters, e.g., is particularly difficult. The radiosurgical measuring equipment available to the medical department of the Nuclear Research Centre Karlsruhe is described. Elimination of the total radioactivity of a wound requires complicated methods and devices. Emergency treatment should be done on the spot whenever possible by washing the wound and applying a compression bandage next to the wound. Subsequent medical treatment will depend on the type and degree of severity of the injury and the radiotoxicity of the substance involved and may consist of conservative or active surgical measures. Medicinal treatment is advisable if one has to reckon with incorporation of a larger dose. This treatment is mainly the administration of $Na_3[Ca\text{-}DTPA]$. (GE)

24387 LYMPHOTACHYMETRY OF SUBMAXILLARY LYMPH NODES WITH MONODISPERSE AND POLYDISPERSE PREPARATION OF ^{198}Au. Zubovskii, G. A.; Zuev, V. P. (Moscow Medical Inst. of Stomatology). Med. Radiol.; 19: No. 7, 71-120(Jul 1974). (In Russian).

A comparative evaluation is given of the rate of accumulation of two preparations of colloid ^{198}Au (monodisperse and polydisperse) in submaxillary lymph nodes. It was established that maximum of accumulation of monodisperse Au was noted in 5 to 6 hours and in 4 hours the intensity of accumulation equalled that of a polydisperse one in 24 hours. The authors recommend monodisperse Au, which made it possible to conduct scanning or scintigraphy on the day of investigation and reduce the size of the introduced activity by 20%. (auth)

24388 USKORENIE VYVEDENIYA IZ ORGANIZMA RADIOAKTIVNYKH IZOTOPOV. (Acceleration of Radioisotope Elimination from the Body). Koval, Yu. F. Moscow; Atomizdat (1972). 200p.

The general characteristics of methods used are given. The basic principles and recommendations on the reduction of the intake and acceleration of elimination of radioisotopes from the bodies of animals and humans are reported. Secondary effects, observed during the acceleration of the elimination of radioactive materials from the body (effect of osmotic diuresis, for example), are described. (tr-auth)

24389 LONG-LIVED ISOTOPES ARISING FROM NUCLEAR POWER PRODUCTION: ^{3}H AND ^{85}Kr. Bond, V. P. (Brookhaven National Lab., Upton, NY). pp 511-532 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

Because of their long half-life and capability of becoming widely distributed in the biosphere, ^{3}H and ^{85}Kr could lead to low-level contamination of a large segment of the biosphere. Sources of tritium, body distribution and excretion of HTO, dose to population from HTO, concentration in organo, concentration in food chains, ^{3}H in DNA and RNA, effects on the embryo, mass isotope effect, sources of ^{85}Kr, calculation of dose equivalent, and dose to public from ^{85}Kr are considered. (MCG)

24390 CALCIUM-47 KINETIC STUDIES IN METABOLIC BONE DISEASES. Tomita, A.; Takatsuki, K.; Imagawa, T.; Uchikawa, T.; Fukita, T. (Nagoya Univ., Japan). Kaku Igaku; 11: No. 2, 87-95(Apr 1974). (In Japanese).

Calcium, phosphorus, and nitrogen balances and calcium kinetic studies for the purpose of the analysis of bone metabolism were performed in 17 metabolic bone diseases–5 patients with postmenopausal osteoporosis, 6 patients with Cushing's

syndrome, 3 patients with chronic renal failure, one with hyperthyroidism, one with secondary hyperparathyroidism, one with bone metastasis of thyroid carcinoma. Kinetic analyses were carried out according to the single compartment model and the miscible calcium pool (E), the calcium turnover rate (K), the bone formation rate (BFR) and the bone resorption rate (BRR) were calculated by the equations of Heaney and Whedon, and Aubert, Bronner, and Richelle. The patients with postmenopausal osteoporsosis had a reduced E, a decreased K and BFR, and an increased BRR. Calcium and phosphorus balances were significantly negative. In patients with Cushing's syndrome, E, BFR were decreased and BRR were increased as well as in patients with postmenopausal osteoporosis. In 3 patients with chronic renal failure, a patient without azotemia had a decreased BFR and BRR but BRR never exceeded BFR while two patients with azotemia had negative calcium balances. In a patient with hyperthyroidism a marked increase of E, BFR, and BRR, and negative calcium balance were observed as well as in a patient with secondary hyperparathyroidism. A patient with bone metastasis of thyroid cancer had negative calcium balance caused by a decreased BFR. These parameters were helpful in elucidating the pathogenesis of various metabolic bone diseases and it is suggested that bone manifestations in these diseases resulted partly from the prolonged negative calcium balance. In addition, three patients with postmenopausal osteoporosis were studied by balance and ^{47}Ca kinetic studies in order to determine the effect of a drug, vitamin K_2. This therapy caused a decrease in the degree of negative balance with a reduction of pains. (auth)

Animals

Refer also to abstracts 23981, 24000, 24300, and 24457.

24391 (CONF-740826-1) AVAILABILITY OF ^{137}Cs TO FISHES FROM INGESTED CLAYS. Eyman, L. D.; Kitchings, J. T. (Oak Ridge National Lab., Tenn. (USA)). 1973. 16p. Dep. NTIS $4.00.

From international association of limnology meeting; Winnipeg, Canada (22 Aug 1974).

The biological availability of ^{137}Cs to bluegill (Lepomis macrochirus) and channel catfish (Ictalurus punctatus) from ingested clay minerals was investigated. Species differences in the uptake and elimination of ^{137}Cs and the effect of temperature on assimilation and retention of ^{137}Cs in these species were also studied. No species differences or effects of temperature treatment at 13 and 25°C were noted. The results suggest that under certain conditions ^{137}Cs accumulation in fish can be greatly influenced by the passive ingestion of sediment clays containing radioactive cesium and the availability of the nuclides for assimilation as determined by the binding capabilities of the clay fraction. (CH)

24392 (GSF-K-28) EXCRETORY INTENSIFICATION OF RADIOISOTOPES. Kriegel, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz). Jan 1972. 42p. (In German). INIS.

A survey of the most important results on the problem of the excretory intensification of radioisotopes from the organism was given. It was assumed that the knowledge of the resorption, distribution, and spontaneous excretion of the radioisotopes was a necessary basis for a particular therapy for radionuclide poisoning. The present known possibilities for decorporation of radio-elements are individually discussed and the most important results are given. (INIS)

24393 RELATIONSHIP BETWEEN TOTAL AND HEME ^{59}Fe UPTAKE OF FEMORAL BONE-MARROW AND SPLEEN IN IRRADIATED RATS. Goeksoy, K. (Ankara Nuclear Research Center). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 2, 99-108(Jun 1974).

In Swiss Albino rats by depressing erythropoietic activity with 650 rads whole-body x-irradiation and transplanting different number of syngenic nucleated bone-marrow cells after irradiation to see whether the total uptake of ^{59}Fe into erythropoietic tissue or heme fraction uptake of ^{59}Fe is a reliable measure for erythropoiesis and heme synthesis. The results obtained showed that the total iron uptake or uptake into heme in erythropoietic tissues can be used as a measure of erythropoiesis and heme synthesis in these rats. (auth)

24394 ISOLATION OF THE ^{67}Ga-ACCUMULATING FRACTION IN NORMAL RAT LIVER. Aulbert, E. (Freie Univ. Berlin (F. R. Germany). Inst. fuer Klinische Physiologie); Haubold, U. (Freie Univ. Berlin (F. R. Germany). Strahlenklinik und Poliklinik). Nucl.-Med.; 13: No. 1, 72-84(May 1974).

3 figs.; 3 tabs.; 35 refs.

Subcellular ^{67}Ga distribution was investigated in normal rat liver after intravenous injection. By differential centrifugation and density gradient centrifugation ^{67}Ga-accumulating bodies were isolated and identified as lysosomes by enzyme determination and electron microscopy. ^{67}Ga enrichment in this fraction was 23-fold. Using the isolated ^{67}Ga-accumulating lysosomes the binding state of the isotope inside the lysosomes was studied. ^{67}Ga was found to be associated with the soluble fraction of lysosomes. (auth)

24395 RADIOEKOLOGIYA VODNYKH ORGANIZMOV. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. (Radioecology of Water Organisms. III. The Effect of Ionizing Radiation on Water Organisms). Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). 152p.

Separate abstracts were prepared for each of the 17 papers. (MCG)

For abstracts of individual papers see: 23564, 23565, 23593, 24305–24307, 24359, 24360, 24374–24378, 24396, 24397, 24411, and 24412.

24396 ACCUMULATION OF ^{90}Sr, ^{90}Y, AND THE EFFECT OF THOSE ELEMENTS DISSOLVED IN WATER ON EMBRYONIC DEVELOPMENT OF SOME FISH SPECIES IN THE CASPIAN SEA. Dokholyan, V. K.; Kostrov, B. P.; Bityutskaya, G. S. pp 36-44 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

During embryogenesis ^{90}Y accumulates several times more than ^{90}Sr. The bulk of ^{90}Y accumulates on the membrane of eggs while part of ^{90}Sr (it depends on fish species) gets through the membranes and accumulates in the tissues of the embryo. Radionuclides are accumulated more intensely by larvae than by eggs. Incubation of eggs in radioactive solutions at an activity lower than $n \times 10^{-6}$ Ci/l does not cause an increase in death rate. Only when the activity reaches $n \times 10^{-6}$ Ci/l a certain increase of embryo fatality is observed statistically. At low concentration ($n \times 10^{-10}$ Ci/l) gas exchange of the embryo is stimulated; at high concentration ($n \times 10^{-6}$ Ci/l) it is oppressed. (auth)

24397 ACCUMULATION OF $^{90}Sr-^{90}Y$ AND ITS EFFECT ON EGGS AND LARVAE OF CTENOPHARYNGODON IDELLA. Nilov, V. I. pp 62-69 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The coefficients of accumulation of ^{90}Sr and ^{90}Y by the developing Ctenopharyngodon idella eggs in $^{90}SrCl_2$ solutions of different activities are quantities of the same order while the dynamics of the accumulation are different. Increase of MPC of $^{90}Sr-^{90}Y$ in water by four to six orders leads to a considerable increase of the death of the Ctenopharyngodon idella eggs and output of larvae with morphological anomalies. (auth)

24398 ON THE PROBLEM OF THE EXCRETION OF TRITIUM VIA MILK FOLLOWING A CHRONIC INTAKE OF TRITIUM WATER. P. 1. Kistner, G. (Bundesgesundheitsamt, Berlin (F.R. Germany). Abt. fuer Strahlenhygiene). Atomkernenergie; 23: No. 3, 167-171(1974). (In German).

6 figs.; 2 tabs.; 23 refs.

A chronic intake of tritium in lactating cows leads to an exchange of certain components of the organically bound hydrogen present in the milk with tritium. After the biological equilibrium is achieved, this share can be 5 to 10% of the total tritium activity excreted in the milk. The specific activity in the organic components of the milk is however at this point less than the specific activity of the milk water. No further concentration of tritium takes place, merely a delay in the excretion and thus a prolonged retention of tritium in the organic substance of the milk. (GE)

24399 EFFECT OF PENTACIN AND LYDASE ON THE RATE OF ^{241}Am ELIMINATION FROM THE BODY OF RATS. Karpova, V. N.; Kalmykova, Z. I. Gig. Sanit.; No. 6, 47-51(Jun 1974). (In Russian).

The preventive use of pentacin with lydase causes a five-fold fall in ^{241}Am content, produced in first 24 hours, and is, consequently, able to diminish coasiderably the intratracheal radiation effect and convert it into a lighter form. The effect of the combined use of both compounds in their single introduction after poisoning with americium depends on the time of their introduction. A significant fall in the content of radionuclides in rats was noted only on conditions of the use of pentacin and lydase in the 1st 24 hours after poisoning. In case of repeated use of the compounds the preventive effect was mainly due to the first administration. (auth)

24400 EFFECT OF CERTAIN CHEMICAL ELEMENTS ON THE ACCUMULATION OF ^{137}Cs IN FRESHWATER FISH. Pakulo,

A. G. (Inst. of Biophysics, Moscow). Gig. Sanit.; No. 6, 111-113 (Jun 1974). (In Russian).

Under experimental conditions it was observed that the variation in the concentration of Mg, Na, SO_4^{2+}, and HCO_3 in water does not affect the concentration of ^{137}Cs in the organs of freshwater fish. With increase of the chloride concentration in the water 10 to 20 times the coefficients of accumulation of ^{137}Cs in the bone tissue decreases 2 to 3 times and in the muscles 3 to 4 times. (tr-auth)

24401 KINETICS OF ^{244}Cm ACCUMULATION IN ORGANS AND TISSUES OF RATS IN CHRONIC INTRODUCTION OF THE ISOTOPE INTO THE BODY. Moskalev, Yu. I.; Zalikin, G. A.; Semenov, A. I. Gig. Sanit.; No. 6, 41-43(Jun 1974). (In Russian).

The kinetics of ^{244}Cm accumulation in case of chronic subcutaneous introduction of the isotope was studied in experiments performed on rats. The data show that an intensive accumulation of ^{244}Cm takes place for 32 to 64 days. The amount of isotope accumulated was determined in the liver, kidneys, and other organs; however, in the bone it never attained a balanced level during 256 days of the experiment. The possible reasons for the low ^{244}Cm deposit in the skeleton in case of chronic introduction of the isotope are discussed. (auth)

24402 DISTRIBUTION OF URANIUM IN THE BODY AFTER SINGLE AND CHRONIC ENTRY OF URANIUM OXIDE-PENTOXIDE. Galibin, G. P. Gig. Sanit.; No. 6, 37-40(Jun 1974). (In Russian).

The coefficients of uranium retention in the body in case of single introduction by oral and respiratory routes of U_3O_8 (0.1 and 25% respectively) were determined in experiments performed on rats. The periods of half-elimination of uranium from the skeleton (T_{eff}-300 days), the lungs (10% of initially retained isotope is eliminated at T_{eff} 250 to 300 days) and other organs were determined. The periods of half-elimination from the kidneys, liver, and spleen do not exceed 16 of 32 days. In a chronic daily inhalation of U_3O_8 at a concentration of 1 mg/m^3 (0.85 mg/m^3) in the rats' lungs the tissue doses may be about 30 ber/year, that is two times higher than the recommended maximal permissible levels. (auth)

24403 EFFECT OF AN ISOTOPE CARRIER (^9Be) ON THE DISTRIBUTION OF ^7Be IN THE ORGANS AND TISSUES OF RATS. Bugryshev, P. F.; Moskalev, Yu. I.; Nozarova, V. A. Gig. Sanit.; No. 6, 43-47(Jun 1974). (In Russian).

The effect of the weight dose of ^9Be on the distribution of ^7Be in case of its introduction by respiratory and oral routes and its application on the skin was studied in tests carried out in 112 rats. In inhalation of beryllium it is mainly deposited in the lungs and the skeleton and following oral introduction and application on the skin, in the skeleton, liver, and kidneys. In the lungs 17.5 per cent of the amount of ^7Be inhaled is retained. On inhaling "weightless" ^7Be Cl, 37.5 per cent of the isotope is eliminated with a biological period of half-eliminations amounting to 24 hours and 62.5 per cent with a period of half-elimination equalling 40 days. The amount of ^7Be absorbed from the gastrointestinal tract ranges from 0.14 to 0.21 per cent. The increase of the dose of stable beryllium from 0.00003 to 6 mg has no practical effect on the extent of its absorption from the gastrointestinal tract. (auth)

24404 TETRACYCLINE ANTIBIOTICS AND RADIOSTRONTIUM METABOLISM. Maljkovic, T.; Dekanic, D.; Kostial, K. (Inst. for Medical Research and Occupational Health, Zagreb). Arh. Hig. Rada Toksikol.; 25: No. 1, 33-38(1974). (Serbocroatian).

The effectiveness of tetracyclines in the prevention and treatment of radiostrontium poisoning was estimated in female rats aged 8 to 9 weeks. Different doses of oxytetracyclines (OTC) were applied either intraperitoneally (18.8 to 300 mg/kg) or orally (600 to 7500 mg/kg) in rats over a period of 7 days. Strontium-85 was given once either intraperitoneally or orally on the 4th day of experiment. The whole body retention of radiostrontium was determined 72 hours later, at the end of the experiment, in a twin crystal scintillation counter. At lower dose levels the application of OTC had no influence on strontium metabolism. At higher dose levels they caused an increased absorption and retention of radioactive strontium. Our results indicate that oxytetracyclines should not be used in the prevention or treatment of radiostrontium poisoning. (auth)

24405 SURVIVAL OF $^{125}IUDR$ LABELED TUMOR CELLS IN THE BLOOD STREAM. Pitzurra, M.; Marconi, P.; Bistoni, F.; Palumbo, R.; Corso, S. (Univ. of Perugia, Italy). Boll. Ist. Sieroterap. Milan.; 52: 349-356(1973).

The fate of $^{125}IUDR$ labeled ATPC+ cells from a spontaneous mammary tumour of BALB/c mice inoculated in Swiss mice was studied. Whole-body radioactivity counting was done at regular intervals after inoculation and at the end of the experiment the counts/gr/min in different organs were assessed. $^{125}IUDR$-ATPC+ cells e.v. inoculated were almost completely eliminated within 18 hours, with a biological rapid half-life of 3 hours, at a rate of 8666 cells/min in the first five hours. After 63 hours only traces of radioactivity were detected, mainly in the spleen. Cells of the same tumour i.p. or s.c. inoculated were eliminated more slowly; after 83 hours a high percentage of the injected radioactivity was still present, mostly concentrated in the developing tumour mass. Old animals eliminated e.v. injected tumour cells more slowly than did young animals and showed a particularly high accumulation of radioactivity in the lungs. (auth)

24406 INFLUENCE OF INJECTED TRITIATED THYMIDINE ON THE MITOTIC CIRCADIAN RHYTHM IN THE EPITHELIUM OF THE HAMSTER CHEEK POUCH. Moeller, U.; Larsen, J. K.; Faber, M. (Finseninstitutet, Copenhagen). Cell Tissue Kinet.; 7: No. 3, 231-239(May 1974).

From 5th meeting of the European Study Group for cell proliferation; Sandefjord, Norway (27 Jun 1972).

The initial effect of an injection of TdR-5-^3H (1 μCi/g body weight; 6 Ci/mmol) in the cheek pouch epithelium of the Syrian hamster is an increase in the mitotic index. The increase is observed 1 to 5 hr after injection, depending upon the time of day when the injection is given, and is followed by compensatory variations in mitotic index. This deviation from the normal circadian rhythm in the mitotic index appears to depend on the fraction of G_2-cells at the time of injection. The main effect is a shortening of t_{g_2}. No effect is observed after injection of non-radioactive TdR or isotonic saline. The results of the present experiment emphasize that unexpected results may be obtained when using mitotic indices from animals labelled with ^3H-TdR, as well as the risks of using the PLM-method in a partially synchronized system. (auth)

24407 KINETICS OF RADIOIODINE ELIMINATION. Popovic, S.; Simonovic, I.; Jovanovic, V. Arh. Hig. Rada Toksikol.; 22: No. 3, 221-233(1971). (In Serbo-Croatian).

Applying mathematical solutions of a six-compartment model of iodine kinetics, radioiodine elimination and certain possibilities of enhancing it were studied. The simplest seems to be the blocking of iodine entry into the thyroid. The blocking of iodine binding in the thyroid is also a very efficient way of enhancing elimination. (Bull. Sci. Sect. A)

24408 KINETIC AND IMMUNOLOGICAL INVESTIGATIONS THROUGH ^{131}I HSA MICROSPHERES OF DIFFERENT SIZE. Blottner, A.; Deckert, H. (Staedtisches Klinikum, Berlin). Isotopenpraxis; 10: No. 6, 230-233(Jun 1974). (In German).

HSA (human serum albumin) microspheres of four defined sizes labelled with ^{131}I were experimentally investigated on rats. With diameters more than 2 μm accumulation of particles preferably took place in the lungs, while with diameters less than 2 μm they were above all accumulated by the RHS of the liver and the milt. Activity loss was pursued up to a 72 hours' time. Metabolism has not yet been cleared up in detail. Determination of electrophoretic mobility was performed with regard to the possibility of selective milt representation. (auth)

Plants

24409 (BNWL-SA-4945) DEPOSITION OF AIRBORNE PARTICULATES ONTO PLANT LEAVES. Klepper, B.; Craig, D. K. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. Contract AT(45-1)-1830. 18p. (CONF-740656-1). Dep. NTIS $4.00.

From meeting of the American Society of Plant Physiologists; Ithaca, New York, USA (17 Jun 1974).

In order to assess potential environmental hazards from foliar absorption of airborne pollutants released in stack effluents from industrial plants, it is necessary to measure deposition characteristics onto plant foliage. An exposure chamber is described, which permits highly toxic materials, such as plutonium compound aerosols, to be delivered to plant leaves under reproducible conditions of wind speed and aerosol concentration. An aerosol of a gold colloid labelled with ^{198}Au and having an AMAD of about 0.8 μm was used in experiments with bean leaves and with inert surfaces. Measurements were made of leaf projection area, wind speed, and aerosol concentration and particle size distribution. Leaves oriented toward and away from winds of 0.42 cm/sec showed similar deposition rates for particles within AMAD of about 0.8 μm. Deposition velocities for leaves were similar to deposition velocities measured for upward facing inert surfaces, which were an order of magnitude greater than downward-facing surfaces for the aerosols and wind velocities used in these experiments. (auth)

24410 (STR-5) ISOTOPES AND RADIATION IN AGRICULTURAL RESEARCH IN THE SOVIET UNION. Report of Study Tours Conducted 2 August–10 September 1971 and 3 July–4 August 1972. Micke, A.; Nethsinghe, D.; Sigurbjoernsson, B. (International Atomic Energy Agency, Vienna (Austria)). Dec 1973. 111p. IAEA $4.50.

Research programs in agriculture in the USSR in which radioisotopes and radiation are used are briefly reviewed. (CH)

24411 INCORPORATING ^{3}H, ^{14}C, AND ^{91}Y IN CHROMOSOMES OF DINOFLAGELLATA. Polikarpov, G. G.; Tokareva, A. V.; Tsypugina, V. G. pp 70-72 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Localization of thymidine, labelled with ^{3}H, ^{14}Ca, and ^{91}Y, in cells of the marine microphyton Prorocentrum micans was studied by microautoradiography. It was found that ^{3}H, ^{14}O, and ^{91}Y are included in chromosomes of algae. (auth)

24412 METHODS OF DETERMINATION OF THE ACCUMULATION OF RADIONUCLIDES BY PLANTS FROM AQUATIC ENVIRONMENT. Kharchuk, A. I. pp 128-132 of Radioekologiya Vodnykh Organizmov. III. Vliyanie Ioniziruyushchei Radiatsii na Gidrobionty. Andrushaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The accumulation of radionuclides of ^{32}P, ^{45}Ca and ^{90}Sr by peas was studied. It was shown that in studies of potential accumulative abilities of plants both the concentrations of radionuclides and the components of nutritional medium are to be kept constant. (auth)

New Tracer Techniques

Refer also to abstracts 23511, 23549, 23714, 24132, 24259, 24381, 24385, and 26196.

24413 (AD-758814) BERYLLIUM UPTAKE BY THE COMMON GUPPY USING RADIOISOTOPE Be-7. I. Preliminary Study: Tracer Mechanics and Procedures. Final Report. Damm, F. C.; Slonim, A. R. (Aerospace Medical Research Lab. (6570th), Wright-Patterson AFB, Ohio (USA)). Oct 1972. 17p. (AMRL-TR-72-94). NTIS.

The mechanics and several variables concerning the use of radioactive beryllium, ^{7}Be, and the possible interaction between beryllium solutions and glass were studied prior to the application of the isotope (in follow-on phase) as a monitor of beryllium toxicity in guppies. Radioactivity was measured in a scintillation counter incorporating a sodium iodide well detector. Tracer activity of efficiency was evaluated under various conditions (e.g., isotope concentration, storage in glass over time, and counting geometry relative to sample size and position in detector). Tracer activity was proportional to tracer concentration and unaltered in a glass container for a period up to 8 days. Under the conditions of this study, beryllium was not lost from $BeSO_4$ solutions in glass bioassay jars due to adsorption onto the glass or evaporation. Counting efficiency was relatively independent of sample size or position within well detector, so that water samples and exposed fish can be treated alike relative to the detector geometry. A procedure was outlined for estimating beryllium uptake in fish exposed to aqueous beryllium solutions to which tracer has been added. (Selec. Water Resour. Abstr.)

24414 (AD-758815) BERYLLIUM UPTAKE BY THE COMMON GUPPY USING RADIOISOTOPE Be-7. II. Beryllium Concentration in Fish. Final Report. Slonim, A. R.; Damm, F. C. (Aerospace Medical Research Lab. (6570th), Wright-Patterson AFB, Ohio (USA)). Oct 1972. 25p. (AMRL-TR-72-95). NTIS.

Two bioassays were conducted in which radioactive beryllium, ^{7}Be, was added as a tracer to beryllium sulfate solutions in order to obtain some insight into beryllium toxicity in fish. Tracer mechanics and procedures for measuring beryllium uptake in guppies were determined in the previous phase. The bioassay data indicated that the amount of beryllium concentrated within the guppies (and fry) was influenced by the beryllium concentration in solution and by fish size (inversely), and to a less extent by exposure period, but not by fish age, buffering to the beryllium solution, or water hardness. Generally, beryllium uptake varied greatly among guppies exposed to the same environmental conditions. Examination of individual tissues and organs of six of the guppies revealed that most of the beryllium was concentrated in the viscera; beryllium uptake was highest (per total organ) in the gastrointestine and kidney of the 9 organs analyzed provisionally. These studies suggest that the lethality of beryllium in fish is not dependent upon the amount concentrated within the fish, but more likely on the effect of beryllium on a particular target organ, cellular or subcellular component. More work is required to determine the mechanism of beryllium toxicity in fish. (Selec. Water Resour. Abstr.)

24415 (CONF-740708-48) SODIUM KINETICS IN HYPERTONIC SALINE ABORTION. Telfer, N.; Ballard, C. S.; McKee, D. R. (Los Angeles County – Univ. of Southern California Medical Center, Los Angeles (USA)). 1974. 9p. (SM-185/22). Dep. NTIS $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The sodium kinetics of hypertonic saline abortions were followed by measuring radioactivity, sodium concentrations in amniotic fluid, maternal plasma, urine, the fetus, and placenta following intrauterine installation of 20% hypertonic saline labeled with ^{22}Na in order to determine the reason for abortion of a dead fetus in 24 to 48 hours, and reasons for sodium reactions. (auth)

24416 (COO-3012-31) TUMOR THERAPY WITH RADIOLABELED HETEROLOGOUS ANTIBODY. Tenth Annual Report. Reif, A. E. (Boston City Hospital, Mass. (USA)). 15 Jul 1974. Contract AT(11-1)-3012. 6p. Dep. NTIS $4.00.

24417 (COO-3173-12) INFLUENCE OF IODINE INTAKE UPON KINETICS OF IODINE METABOLISM IN THE DOG. Progress Report, November 1, 1971–October 31, 1974. Becker, D. V.; Belshaw, B. E. (Cornell Univ., New York (USA). Dept. of Medicine). 1974. Contract AT(11-1)-3173. 10p. Dep. NTIS $4.00.

24418 (FMI-41) SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION. Gottschalk, A. (ed.). (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). Mar 1974. Contract AT(11-1)-69. 142p. Dep. NTIS $5.45.

Separate references are provided for each of the 12 sections. Staff publications are listed. (MCG)

For references to individual sections see: 24419–24424, and 26208–26213.

24419 (FMI-41, pp 1-13) SYNTHESIS AND DEGRADATION OF MITOCHONDRIAL COMPONENTS IN HYPERTHROPHIED RAT HEART. Albin, A.; Dowell, R. T.; Zak, R.; Rabinowitz, M. Mar 1974.

In semiannual report to the Atomic Energy Commission.

Studies were conducted to determine whether or not mitochondrial components accumulate in parallel with other cell components in the early period after induction of rapid cardiac enlargement by constriction of the ascending aorta. Relative changes in mitochondrial mass were estimated from measurements of mitochondrial cytochrome content and respiratory enzyme activities. Incorporation of δ-amino [2,3-$^{3}H_2$] levulinate into cytochrome c was studied and procedures are described for determination of radioactivity in free δ-aminolevulinate and in cytochrome c. (HLW)

24420 (FMI-41, pp 24-42) PRIMARY HYPERPARATHYROIDISM: A COMPREHENSIVE STUDY OF CLINICAL, BIOCHEMICAL, AND RADIOGRAPHIC MANIFESTATIONS. Genant, H. K. (Univ. of Chicago); Heck, L. L.; Lanzl, L. H.; Rossmann, K.; Vander Horst, J.; Poloyan, E. Mar 1974.

In semiannual report to the Atomic Energy Commission.

The clinical manifestations, laboratory tests, radiographic findings, and bone mineral measurements of a large group of patients with primary hyperparathyroidism are discussed. A new technique was used for quantitative analysis of bone mineral; the method consists of measuring the transmission through a finger of a narrow collimated beam of radiation emanating from an ^{125}I source. Enhanced diagnostic capability was provided by fine-detail radiography with optical magnification. (HLW)

24421 (FMI-41, pp 48-57) WHOLE-BODY RADIOGALLIUM SCANNING FOR STAGING OF HODGKIN'S DISEASE AND OTHER LYMPHOMAS. Hoffer, P. B.; Turner, D.; Gottschalk, A.; Harper, P. V.; Ultmann, J. E. Mar 1974.

In semiannual report to the Atomic Energy Commission.

The preparation of carrier-free ^{67}Ga-citrate as the scanning agent is described. The scan is performed with a dual 5-inch rectilinear scanner using a focused collimator with 9 cm focal length. Scans were performed on more than 100 patients with Hodgkin's disease or other lymphoma and data were evaluated on 24 patients with Hodgkin's disease, 6 patients with malignant lymphoma, and 4 additional cases. Evaluations of the scans in the abdomen, the thorax, and extranodal regions are discussed. Future developments are considered. (HLW)

24422 (FMI-41, pp 58-67) REDISTRIBUTION OF MIXED LYMPHOCYTE CULTURE-REACTIVE CELLS AFTER ANTIGEN ADMINISTRATION. Larner, B. J. Mar 1974.

In semiannual report to the Atomic Energy Commission.

Investigations were conducted on the effect of injection of semiallogeneic cells on the subsequent mixed lymphocyte culture (MLC) reactivity of peripheral blood lymphocytes and spleen cells in the rat. Tritium-labeled thymidine was added to lymphocyte cultures. Results showed that intravenous administration of semiallogeneic lymphoid cells produced a rapid specific decrease in the MLC reactivity of peripheral blood lymphocytes with a simultaneous increase in the MLC reactivity of splenic lymphocytes. (HLW)

24423 (FMI-41, pp 68-76) RAPID INCORPORATION OF SHORT-LIVED CYCLOTRON-PRODUCED RADIONUCLIDES INTO RADIOPHARMACEUTICALS. Lathrop, K. A.; Harper, P. V.; Rich, B. H.; Dinwoodie, R.; Krizek, H.; Lembares, N.; Gloria, I. Mar 1974.

In semiannual report to the Atomic Energy Commission.

The following studies on clinical feasibility of short-lived radionuclides are described: use of $^{13}NH_4^+$ for imaging of the myocardium; use of ^{13}N-glutamate for improved imaging of the pancreas; and metabolism of 2-^{11}C-acetate. Radionuclide production methods, chemical syntheses, pharmaceutical production, and clinical efficacy are discussed. The studies demonstrate the feasibility of synthesizing radiochemicals from short-lived cyclotron-produced radionuclides and of preparing them as pharmaceutical quality solutions for injection. (HLW)

24424 (FMI-41, pp 77-88) GUANOSINE 5'-PHOSPHATE REDUCTASE OF HUMAN ERYTHROCYTES. MacKenzie, J. J.; Sorensen, L. B. Mar 1974.

In semiannual report to the Atomic Energy Commission.

Studies are reported on the existence of a guanosine-5'-phosphate (GMP)-reductase in human erythrocytes with a triphosphopyridine nucleotide (NADPH)-linked activity and on the partial purification and characterization of the enzyme. Carbon-14 was used as a tracer. (HLW)

24425 (FMI-1000-529) STAGING LAPAROTOMY IN NON-HODGKIN'S LYMPHOMAS. Moran, E. M.; Ultmann, J. E.; Ferguson, D. J.; Hoffer, P. B.; Ranniger, K.; Rappaport, H. (Chicago Univ., Ill. (USA); Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1973. 29p. (CONF-731085-1). Dep. NTIS $4.50.

From symposium on non-Hodgkin's lymphomas; London, UK (8 Oct 1973).

In 57 patients with non-Hodgkin's lymphoma, a clinical, radiographic, scintigraphic, and pathological correlative study showed that the inferior venacavagram, lymphangiogram, and ^{67}Ga scan have a low sensitivity in detecting lymphoma. Their accuracy was high when the findings are interpreted as abnormal (93%, 83%, and 80%, respectively), but low when interpreted as normal (47%, 67%, and 58%, respectively); the clinical evaluation of spleen and liver was unreliable, the incidence of lymphocytic lymphoma in the paraaortic-iliac nodes was high; a pattern of involvement by contiguity and a predilection for the spleen were observed in lymphocytic lymphoma; in lymphocytic lymphoma there was no liver involvement without concomitant splenic involvement; and no definite pattern of spread could be seen in histiocytic lymphoma. Surgical staging changed the classification of the lymphoma in 56% of cases, with 46% reclassified to a more advanced stage, and improved the assessment of the stage of disease, therefore permitting accurate treatment planning. (auth)

24426 (IAEA-R-544-F) A. THE DISTRIBUTION AND ACTIVITY OF THE ROOT SYSTEM OF COCOA. B. EFFICIENCY OF FERTILIZER USE BY COCOA, THROUGH THE USE OF RADIOISOTOPES. Part of a Coordinated Programme on the Use of Isotopes to Study the Efficient Use of Fertilizers in Tree Culture. Final Report, 1 August 1967–31 May 1972. Ahenkorah, Y. (International Atomic Energy Agency, Vienna (Austria)). Oct 1973. 8p. INIS.

Using a ^{32}P soil injection technique, the intensity and distribution of root activity of mature 20 year old cocoa trees, variety Amelonado, was studied in order to determine the best zones and times for applying fertilizers. The ^{32}P content of recently matured young leaves in the upper part of the trees was used as a measure of root activity. The trees were planted at a spacing of 2.4 × 2.4 meters on a dark greyish-brown sandy loam soil type Jumapo series. The intensity of root activity in the wet season was about six times as high as in dry weather. In both wet and dry seasons, highest root activity was in the upper 2.5 cm layer of soil at 150 cm distance from the tree. In dry weather root activity at lower depths (up to 45 cm) was not much less than in the upper layers. In a wet season experiment comparing different varieties of 14 year old cocoa trees (Amazon X Amelonado, Amelonado X Amazon, pure Amazon and Amelonado) planted at a spacing of 3 m × 3 m on the same sandy loam soil type, it was found that all varieties took up most ^{32}P from the upper 7.5 cm of soil, with maximum uptake from the 2.5 cm depth. The highest yielding variety, Amelonado X Amazon, showed highest ^{32}P uptake at all depths. Pure Amazon, also a higher yielder, took second place at 2.5 and 7.5 cm depths, but showed lowest root activity at lower depths. Pure Amelonado proved to be second-best in phosphate uptake at lower depths. This information should prove useful in the selection of fertilizer-responsive and drought-resistant varieties. An experiment with ^{32}P labeled superphosphate to test the efficiency of different methods of applying fertilizer showed that for maximum utilization by the plantation (treated and border trees) fertilizer should be applied within the surface 2.5 cm of soil in strips at a distance of 170 cm away from the tree—in the middle, between rows of trees. (INIS)

24427 (IAEA-R-594-F) ROOT DEVELOPMENT OF COFFEE TREES. Part of a Coordinated Programme of Research on the Use of Isotopes to Study the Efficient Use of Fertilizers in Tree Culture. Final Report, 1 January 1968–30 September 1971. Perdomo, M. A. (International Atomic Energy Agency, Vienna (Austria)). Dec 1972. vp. (In Spanish). INIS.

Using a ^{32}P soil injection technique, the intensity and distribution of root activity of 8 year old Caturra coffee trees was studied in wet and dry seasons in order to determine the best zones and times for applying fertilizers. The ^{32}P content of young leaves was used as a measure of root activity. The coffee trees were planted at a spacing of 2 m × 2 m. The experiments were done at the Naranjal Research Station of the National Federation of Coffee-Growers at Chinchina, Caldas, Colombia. Root activity was highest in the wet season at a distance of 30 cm from the tree and depth of 15 cm (the other distances tested were 60, 90 and 120 cms, and other depths were 30, 45 and 90 cms). A subsequent experiment with ^{32}P labelled superphosphate to test the efficiency of applying fertilizer showed that for maximum utilization, fertilizer should be applied broadcast round the tree in the entire area under the crown. (INIS)

24428 (IAEA-R-729-F) USE OF ISOTOPES IN STUDIES ON THE NUTRITION OF GROUNDNUTS. Part of a Coordinated Programme on the Use of Isotopes and Radiation in Studies on Physico-Chemical Relationship of Soils and Plants. Final Report, 1 February 1969–30 November 1972. Ofori, C. S. (International Atomic Energy Agency, Vienna (Austria)). Dec 1973. 30p. INIS.

Field experiments were conducted on ground nuts on sandy loam soils using fertilizers labelled with P-32, S-35 and N-15 to investigate methods of phosphate placement, influence of sulfur, and effects of rates and times of nitrogen application on crop yields and efficiency of fertilizer utilization. Phosphorous (superphosphate) gave significant yield responses. Highest kernel yields were obtained when half the phosphate was broadcast at planting and the rest was banded three weeks after germination. Sulfur depressed kernel yields. Sulfur increased the absorption of fertilizer phosphorous in underground portions of the plant, but not in forage. Except on a site under grass-fallow, nitrogen (ammonium-sulphate, urea) showed no yield response beyond 15 kg n/ha. Fertilizer phosphorous absorption increased when nitrogen was applied with the phosphate. Kernel yield was highest when nitrogen was applied at planting. Late application of nitrogen depressed kernel yields, increased efficiency of utilization in one variety, and decreased in another. However, time of nitrogen application had no effect on crude protein content of kernels. (INIS)

24429 (IAEA-R-762-F) DEVELOPMENT OF NEW RADIOPHARMACEUTICALS. Final Report, 1 August 1969–3 November 1972. Ganatra, R. D. (International Atomic Energy Agency, Vienna (Austria)). Mar 1973. 22p. INIS.

The work on this contract consists of: development of new radiopharmaceuticals; new applications of currently available radiopharmaceuticals; uses of generator-produced radionuclides; and preparation of labelled compounds for in-vitro assay techniques. Work on ^{131}I-synkol and its analogues as possible tumor scanning agents was carried out. The distribution of miscellaneous labelled compounds (^{131}I-berberine as a possible pancreas scanning agent; ^{203}Hg-hydroxymercuryfluorescein as a possible myocardial and tumor scanning agent; ^{131}I-iodopropamide as a possible pancreas scanning agent; ^{203}Hg-methimazole as a possible adrenal scanning agent; and ^{131}I-T4 and T3 as a possible liver scanning agent) in the body tissues was studied after administration by various routes. The distribution of chromic chloride and chromic citrate was compared to that obtained with gallium citrate and indium chloride. Uses of ^{131}I-T3 and ^{99m}Tc as labels for the red cells were explored. An attempt was made to use lysolecithin for denaturing the red cells. Scintigraphic procedures with a gamma camera based on the use of generator-produced radionuclides (^{113m}In and ^{99m}Tc) were introduced into clinical routine. Plasma growth hormone (HGH) levels were also studied in marasmic children by radioimmunoassay with ^{125}I-HGH. The accumulation of hydroxymercuryfluorescein in tumors was sufficiently high to visualize by scintigraphy. It was possible to obtain liver scans after oral or parenteral ad-

ministration of T4 and T3. The distribution of chromic chloride appeared to be similar to that of gallium citrate and indium chloride. Increased concentration of indium citrate and chromic citrate was shown in fractured areas of the bone. It was found that only lysolecithin derived from human subjects gave some degree of denaturation of the red cells. The mean HGH levels in marasmic children was significantly higher than the control values. (auth)

24430 (IAEA-R-814-F) DEVELOPMENT OF RADIOIMMUNOASSAY TECHNIQUES FOR THE MEASUREMENT OF PROTEIN HORMONES. Final Report, 1 November 1969–31 October 1972. Mitta, A. E. A. (International Atomic Energy Agency, Vienna (Austria)). Dec 1972. vp. (In Spanish). INIS.

Labelling procedures utilizing chloramine T as oxidant reagent were developed for the radioiodination of protein hormones. Preparations with specific activities ranging from 90 to 250 mCi/mg were obtained for the following hormones: insulin (pork, beef and human), human growth hormone (HGH), thyroid stimulating hormone (TSH), luteinizing hormone (LH), follicle stimulating hormone (FSH), human chorionic gonadotropin (HCG), human placental lactogen (HPL), parathyroid hormone (PTH), adreno corticotrophic hormone (ACTH), glucagon, gastrin and angiotensin I. Both ^{125}I and ^{131}I were used for labelling. Antisera were raised against insulin and HGH. A compartmental model of HGH distribution was derived from data generated by measurement of samples obtained after injection of *I-HGH in humans. The validation of radioimmunoassays performed with all reagents prepared under the contract was carried out and the assays established. This contract was helpful in the development of radioimmunassays in Argentina, with the utilization of local resources to the greatest extent possible. Medical institutions in Argentina and in neighboring countries are already deriving great benefits from the use of reagents prepared at the research institution and also from the utilization of its facilities for training purposes. (INIS)

24431 (IAEA-R-815-F) IRON NUTRITION IN MEXICO. Part of a Joint IAEA/WHO Coordinated Research Programme on the Use of Radioisotopes in Iron Nutrition Studies. Final Report, 1 December 1969–31 March 1973. Maisterrena, J. A. (International Atomic Energy Agency, Vienna (Austria)). Mar 1973. vp. INIS.

Techniques were established for studying iron absorption from the diet, and have been applied to representative persons eating typical Mexican meals. The primary technique used for the assay of absorbed iron was whole-body counting 3 hours and two weeks after administration of the ^{59}Fe-labeled meal. A small number of studies were performed based upon liquid-scintillation counting of tracer ^{55}Fe or ^{59}Fe after its incorporation into the red blood cells. The most commonly adopted experimental methodology has been to label the meal with an extrinsic tag of ^{59}Fe, i.e., to add this tracer as a solution of an inorganic iron salt to some component of the meal during its preparation. Some studies were made using maize intrinsically labeled with ^{55}Fe by hydroponic growth in a nutrient solution containing ^{55}Fe. Iron absorption studies were performed on 6 groups numbering 78 persons altogether. From these studies it was concluded that: the extrinsic ^{59}Fe tag incorporated into maize tortillas prior to cooking yielded the same estimate of percentage iron absorption as did an intrinsic ^{59}Fe label in the maize, tracer iron incorporated in a drink consumed with the meal tended to be better absorbed than tracer iron mixed in the meal itself, and orange juice, presumably because of its vitamin C, increased the percentage of iron absorbed from a meal by as much as several fold. (INIS)

24432 (IAEA-R-819-F) APPLICATION OF RADIOIMMUNOASSAY AND IMMUNOELECTROPHORESIS TECHNIQUES IN STUDIES OF ENDOCRINE STATUS IN ACUTE INFECTIOUS DISEASES. Final Report, 1 November 1969–30 November 1972. Lee, M. (International Atomic Energy Agency, Vienna (Austria)). Jan 1973. 24p. INIS.

In an attempt to investigate the changes of endocrine function in infectious diseases levels of human growth hormone (HGH), human thyrotropin (h-TSH), and adrenocorticotropin (ACTH) were measured in the blood of the patients with typhoid fever and E. H. fever prevalent in Korea. For the measurement of these hormones radioimmunoassay according to double antibody method was utilized. ACTH measurement was not possible for practical use. The HGH concentration in the normal Koreans in fasting state was 2.06 ± 1.183 mμg/ml (Mean ± 1 S. D.), with the upper limit value of 4.5 mμg/ml, which was comparable to that of non-Koreans. In general there was increasing tendency of fasting HGH levels in patients with typhoid fever, E. H. fever, and tuberculous meningitis. Diurnal rhythm with maximum values at 4:00 P. M. seen in the control group was not present in the febrile phase of typhoid patients; however, the HGH secretion responding to insulin-induced hypoglycemia was normal. In the patients with E. H. fever, especially during oliguric and convalescent phases, fasting HGH level was significantly elevated, however, the response of HGH secretion to hypoglycemia was subnormal. Thyroid and adrenal function were not depressed in these patients. The urinary excretion of 17 OHCS was rather increased in convalescence. A remarkable increase of fasting HGH level was seen in 3 cases of acromegaly. There was no response of HGH to hypoglycemia in 4 cases of hypopituitarism suggesting clinical applicability of HGH radioimmunoassay. The fasting h-TSH level in the normal Koreans was 1.1 ± 0.83 μU/ml (Mean + 1 S. D.) without apparent diurnal rhythm. In the normal Korean, the concentration of IgG, IgM, and IgA was 1.922 ± 305.8, 89.0 ± 13.3, and 333.5 ± 102.6 mg/ml, respectively. There was a significant elevation of IgG and IgM among the patients with typhoid fever and E.H. fever. The level of IgA was not remarkable in both diseases. (auth)

24433 (IAEA-R-825-F) AVAILABILITY OF FOODSTUFF AND SUPPLEMENTAL IRON FROM MIXED DIETS BASED ON WHEAT. Part of a Joint IAEA/WHO Coordinated Programme on the Use of Radioisotopes in Iron Nutrition Studies. Final Report, 1 November 1969–31 March 1973. Pascoe, E. (International Atomic Energy Agency, Vienna (Austria)). Jan 1973. 7p. INIS.

The amount of iron absorbed from the various components of a typical Middle Eastern meal was studied to determine if the meal could be modified so as to increase the amount of iron absorbed. Measurement of absorption was based on assay of ^{55}Fe or ^{59}Fe tracer incorporated into red blood cells two weeks after consumption of the labeled foodstuff. The native iron of four foods was labeled with ^{55}Fe: wheat and chickpeas by injection of a solution of ^{55}Fe into the stem, and eggs and chicken meat by injection of ^{55}Fe into the chicken. These foods were fed either individually or as single labeled components of a meal whose other 3 components were inactive, thereby permitting determination of percentage iron absorption from each foodstuff either alone or as part of a meal. The iron content of Arabic bread was increased either by the addition of ^{55}Fe-labeled chickpea flour to unlabeled wheat flour, or by addition of ^{59}Fe-labeled iron salts to the ^{55}Fe-labeled wheat flour dough, during preparation of the bread. It was concluded that iron absorption from Arabic bread, chicken meat, and chickpeas ("felafel") is slightly decreased when these foodstuffs are eaten alone, while absorption from eggs is slightly increased. Supplementation of Arabic bread with chickpea flour or iron salts leads to a useful increase in iron absorption, especially in persons with low hemoglobin concentrations. (INIS)

24434 (ORNL-4966, pp 32-48) BIOCHEMICAL TECHNOLOGY. Aug 1974.

In Chemical Technology Division annual progress report for period ending March 31, 1974.

Research progress is reported on macromolecular separations, high-resolution analytical systems, water pollution studies, centrifugal fast analyzer development, genetic monitoring, and biological production of fuel gases. (MCG)

24435 (UR-3490-574) SPECIFIC RADIOIMMUNOASSAYS FOR QUANTITATION OF Hb S AND Hb F. Doherty, R. A.; Rowley, P. T.; Cernichiari, E. C.; Keller, M. R.; Porta, C. R. (Rochester Univ., N. Y. (USA). School of Medicine and Dentistry). 1974. 4p. (CONF-740661-1). Dep. NTIS $4.00.

From 1st national symposium on sickle cell disease; Washington, District of Columbia, USA (27 Jun 1974).

Radioimmunoassays that allow identification and quantitation of nanogram amounts of S and F hemoglobins in complex protein mixtures were developed. Purified hemoglobins were injected with Freund's adjuvant into goats, sheep, rabbits, guinea pigs, and chickens. Each antiserum was tested for reactivity against the hemoglobins by quantitative precipitation using purified ^{125}I-labeled hemoglobins and by immunodiffusion. (HLW)

24436 INCORPORATION OF ^{14}C FROM ACETATE INTO PROTEINS AND LIPIDS OF RABBIT ORGANS AND TISSUES IN EXPERIMENTAL BURN DISEASE. Zhurbin, G. I.; Stognii, N. A. (Inst. of Biochemistry, Kiev). Vop. Med. Khim.; 20: No. 3, 284-290(1974). (In Russian).

Rates of protein and lipid biosynthesis were studied in burnt rabbits. At the eighth day of the burn disease (III B degree burn, about 15 to 16% of the body surface) metabolic rate of 2-^{14}C-acetate in tricarbonic acids cycle was distinctly decreased; rate and intensity of incorporation of ^{14}C into proteins of liver, kidney, spleen and blood serum were decreased. But, the specific radioactivity of lipids was increased in the organs and blood serum although the content of lipids was significantly (except that in blood serum) decreased. The maximal radioactivity in proteins and lipids was shifted towards a later period. (auth)

24437 CYCLOTRON PRODUCED SHORT-LIVED ISOTOPES IN NUCLEAR MEDICINE. Carbon-11 Amino Acids. Vaalburg, W. Groningen, Netherlands; Rijksuniveristeit (1974). 81p.

Thesis.

A rapid amino acid synthesis is described based on the carboxylation of alpha-lithioisocyanides with $^{11}CO_2$, followed by hydrolysis of the intermediate reaction product. DL-α-phenylalanine-1-^{11}C and DL-α-phenylglycine-1-^{11}C were obtained with yields between 30 and 80 per cent. These acids were administered intravenously to rats and the pancreas uptake was compared to that of the liver and of some other organs. Comparison with literature data of DL-6-fluorotryptophan-^{18}F uptake ratio for pancreas and liver reveals that the latter compound is more suitable for pancreas visualization in nuclear medicine. (NL)

24438 SOLID-PHASE RADIOIMMUNOASSAY OF RAT SKIN COLLAGENASE. Comparative Studies and In Vivo Measurement of the Enzyme. Eisen, A. Z.; Nepute, J.; Stricklin, G. P.; Bauer, E. A.; Jeffrey, J. J. (Washington Univ., St. Louis). Biochim. Biophys. Acta-Enzymol.; 350: No. 2, 442-454(Jun 1974).

The solid-phase radioimmunoassay for measurement of collagenase in rat skin determines 0.3 to 20 ng of enzyme. The immunoassay is at least 1000 times more sensitive than the enzymatic assay. The similarities between rat skin and rat uterus collagenases, as well as collagenases from a variety of other animal sources, were evaluated by assessing their relative binding capabilities in the solid-phase radioimmunoassay. Rat uterus collagenase was found to be identical in its cross-reactivity with rat skin collagenase in the immunoassay indicating that these rat collagenase are structurally closely related. The cross-reactivity between the collagenase from mouse skin and rat skin collagenase was one of complete immunologic identity although this was not the case for the skin collagenase from another rodent, the guinea pig. This indicates that the solid-phase radioimmunoassay can be used to measure collagenase levels in mouse skin and perhaps other mouse tissues as well. Collagenases from phylogenetically more distant species cross-react much less strongly, suggesting the existence of fewer similarities to the rat enzymes. Quantitative determination of collagenase in rat skin using the solid-phase radioimmunoassay indicates that the enzyme content reaches a maximum during the first 24 h after birth and by one week of age has declined to a level found in the mature animal. (NL)

24439 RED-CELL LIFETIMES CALCULATED FROM ^{51}Cr RED-CELL SURVIVAL DATA. Widman, J.C.; Powsner, E.R. (Veterans Administration Hospital, Allen Park, Michigan, 48101). Med. Phys. 1: No. 2, 58-61 (Mar 1974).

The activity of red cells labeled with ^{51}Cr decreases exponentially due to elution of chromium from the cell and any random cell losses which may be present, and decreases linearly due to red-cell senescence. Red-cell survival data are fitted to the function $a(t) = ae^{-kt}(1-t/L)$, where a(t) is the activity at time t, a is the initial activity, k is the exponential loss rate, and L is the cell lifetime. With many subjects, a, k, and L as well as the standard errors of the estimate of these parameters may be determined. (auth)

24440 DIPHOSPHONATE TREATMENT OF PAGET'S DISEASE OF BONE. A Correlated Metabolic, Calcium Kinetic and Morphometric Study. Guncaga, J.; Lauffenburger, T.; Lentner, Ch.; Dambacher, M. A.; Haas, H. G. (Kantonsspital Basel (Switzerland). Div. of Metabolism); Fleisch, H. (Bern Univ. (Switzerland). Pathophysiologisches Inst.); Olah, A. J. (Bern Univ. (Switzerland). Anatomisches Inst.). Horm. Metab. Res.; 6: No. 1, 62-69(Jan 1974).

From 7th annual meeting of the European Society for Clinical Investigation; Rotterdam, Netherlands (Apr 1973). 6 figs.; 1 tab.; 24 refs.

Eight patients with active Paget's disease of bone were treated with the diphosphonate EHDP for up to ten months. The drug caused no toxic side effects. Bone turnover and remodelling were assessed before and on EHDP by combining the determination of serum alkaline phosphatase and urinary hydroxyproline excretion with complete metabolic balances, ^{47}Ca kinetics, and profile scanning on one hand and histomorphometry of paired bone biopsies on the other. In all patients, EHDP led to a significant decrease of the biochemical and calcium kinetic parameters of bone turnover. In "limited responders", a less marked influence of EHDP on metabolic and histologic parameters of bone turnover was recorded. ^{47}Ca activity profiles over the diseased area remained either unchanged or showed an only limited response. In the sequence of events, urinary hydroxyproline started to decrease first, reaching a new plateau after two months of treatment. Serum alkaline phosphatase followed with a delay time of a further two months. Thus, EHDP inhibits the excessive bone turnover in Paget's disease and may therefore constitute an effective treatment for this condition. (GE)

24441 RADIOACTIVE ISOTOPES USED IN DERMATOLOGIC DIAGNOSIS. Kubickova, V.; Kubicek, M. (Bezirkskrankenhaus Kolin (Czechoslovakia). Haut-Abteilung; Bezirkskrankenhaus Kolin (Czechoslovakia). Radioisotopen-Abteilung). Berufsdermatosen; 22: No. 1, 23-28(Feb 1974). (In German).

4 figs.; 6 refs.

The resorption of radioactive isotopes, and especially of $Na_2{}^{51}CrO_4$ or of labelled components of the skin, was studied in healthy persons and in eczematics who were both sensitized or not, to chromium. The resorption is measured by determining the decrease of the radioactivity. In persons who are sensitized to chromium, the resorption from the skin is accelerated, while it is slowed down in animals exposed several times to chromium. The investigation of the decrease of the activity of radioactive isotopes in the skin is a convenient and reliable method in dermatology. In animals, the sensitivity notion ought to be defined. (auth)

24442 A SENSITIVE MICROASSAY FOR UDP-GLUCURONYLTRANSFERASE IN LIVER HOMOGENATES, USING [^{14}C] P-NITROPHENOL AS SUBSTRATE. Lehnert, W.; Limberg, J.; Kuenzer, W. (Freiburg Univ. (F. R. Germany). Kinderklinik). Z. Klin. Chem. Klin. Biochem.; 12: No. 1, 23-27(Jan 1974). (In German).

3 figs.; 12 refs.

A new micromethod is described for determination of UDP-glucuronyltransferase with [^{14}C] p-nitrophenol as the substrate. Liver homogenates containing as little as 1 to 2 mg of liver tissue are sufficient for the enzyme determination, which has a standard deviation of ±3.3%. The pH-dependency of the glucuronyltransferase, measured by this method, showed a minimum at pH = 7.3 and maximum at pH = 7.4. The sensitivity of the method permitted the demonstration of a reproducible relationship between enzyme activity and time of homogenization. (auth)

24443 FUNDAMENTAL STUDIES OF RADIOISOTOPE RENOGRAM. Comparison of Counts at Different Depths of the Kidney. Komiyama, F.; Ito, O.; Ono, Y. (Yokohama City Univ., Japan). Yokohama Igaku; 23: No. 5, 341-349(Oct 1973). (In Japanese).

The quantitative analysis of the radioisotope renogram is not precise for several reasons. One of the reasons is the individual variation of the depth of the kidney. Variation of counts and spectra relating to different depths of the kidney were studied. Counts of standard source in air were 3 times that in water at the 364 Kev peak. The spectrum showed little change at lower energy levels. Counts from the source 10cm deep were 40 to 50% of that from the source 5cm deep. In five patients who were being treated for uterine carcinoma, counts and spectra showed individual variation. Importance of a depth variation of the kidney in the study of quantitative analysis of radioisotope renogram was discussed. (auth)

24444 APPLICATION OF OXYGEN ISOTOPES IN BIOCHEMISTRY AND BIOLOGY. Staschewski, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Chem. Ztg.; 98: No. 2, 77-84(Feb 1974). (In German).

9 figs.; 2 tabs.; 29 refs.

For over 40 years oxygen-18 has been used as a stable tracer in investigations of chemical and biological processes. The tracer method however does not represent the only way for application of oxygen isotopes. Generally experiments with stable isotopes refer to 5 basic effects or principles which can be classified by terms such as isotope effect, fractionation effect, isotopic label, nuclear magnetic resonance, and nuclear reaction. This review is designed to give a survey on typical experiments and recent developments in the field of the isotopic chemistry and isotopic biology of oxygen. According to the basic effects the scope of the subject matter extends from the nuclear activation analysis to the isotope substitution within living mammals. (auth)

24445 METHODOLOGICAL AND CLINICAL STUDY IN DISEASES OF THE THYROID GLAND. Gordin, A. (Helsinki Univ.). Commentat. Biol.; 72: 1-41(1974).

Thesis.

A modified radioimmunoassay for human serum thyrotrophin (TSH) is reported. Purification of the labelled human TSH by poly(vinylchloride) electrophoresis improved the stability of the tracer and the sensitivity and reproducibility of the assay. All 99 subjects with non-toxic goitre had a normal serum TSH concentration. All but two patients out of 58 with primary hypothyroidism had an elevated serum TSH concentration. The serum TSH concentration was elevated in about 1/4 of the euthyroid subjects who had undergone subtotal thyroidectomy (without recurrent goitre) or radioiodine treatment. Only two out of 19 subjects with recurrent non-toxic goitre had an elevated serum TSH concentration. The serum TSH concentration was elevated in about 1/4 to 1/3 of the subjects with symptomless autoimmune thyroiditis. (auth)

24446 RADIOIMMUNOASSAY OF INSULIN BY THE DOUBLE ANTIBODY METHOD: EVALUATION OF THE TECHNIQUE IN PRACTICE. Wojcikowski, C.; Zakolski, W. (Inst. of Pathology, Danzig). Arch. Immunol. Ther. Exp.; 22: No. 3, 355-368(1974).

A simplified procedure for the radioimmunoassay of insulin by the double antibody method was developed. Anti-insulin serum was obtained by immunizing guinea pigs with porcine insulin suspended in Freund's incomplete adjuvant supplemented with Hemophilus pertussis vaccine. After two injections, sera from four guinea pigs diluted 1:10,000 bound more than 70% of the ^{125}I-insulin added. Under the conditions of the method, the insulin binding reagent bound 43% ± 5% (n = 94) of added ^{125}I-insulin. Accuracy of the method in simultaneous series for insulin concentrations of 27 μU/ml and 49 μU/ml was ±5% and ±7% respectively; and in a nonsimultaneous series of determinations for insulin concentrations of 21 μU/ml and 77 μU/ml, ±11% and ±8%. Recovery of insulin added to human plasma was 104%. Concentrations of insulin in the plasma of healthy fasting subjects ranged from 5–22 μU/ml (m = 13 ± 5 μU/ml; n = 21). The results were in complete agreement with results obtained by the use of the Amersham radioimmunoassay insulin kit. (auth)

24447 IN VITRO TEST USING RADIOISOTOPES. Saito, H. (Nagoya Univ., Japan). Gendai Igaku; 21: No. 1, 25-30(Aug 1973). (In Japanese).

The use of radiopharmaceuticals for diagnostic procedures is discussed. Results of in vitro tests such as saturation analysis and competitive protein binding analysis are tabulated. Radioimmunoassays and other tests are discussed. Substances tested for were triiodothyronine, vitamin B-12, thyroxin, thyroid stimulating factor, human growth hormone, angiotensin, proteins, and antigens. Radioisotopes used were ^{59}Fe, ^{131}I, ^{125}I, and ^{57}Co. (HLW)

24448 RADIOIMMUNOLOGICAL STUDIES WITH BACTERIOPHAGES. Falck, P. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Berlin). Acta Biol. Med. Ger.; 31: 375-382(1973). (In German).

T3- and T4-phages were labelled with ^{125}I, retaining their immunological reactivity. When combined with plastic-fixed antibodies, these labelled phages proved suitable for quantitative determination of unlabelled phages in a competition test. The influence of antiserum dilution, titre, and time on the binding capacity of plastic-fixed antibodies was studied. (auth)

24449 ISOTOPE FILTRATION CLEARANCE IN SOME RENAL DISEASES OF CHILDHOOD. Ignatov, A.; Bojkinov, B. Pediatriya (Moscow); 12: No. 4, 372-374(1973). (In Russian).

Glomerular filtration was determined by an isotope clearance method in 45 children, from 3 to 14 years of age, with miscellaneous renal diseases. Forty of them had also the endogenous creatinine clearance determined for comparison. Both clearances were determined also in 9 normal children for control. The isotopes ^{51}Cr-EDTA, ^{169}Yb-EDTA and ^{115}I-iodalamate were used. No statistically significant difference in the values of the two compared clearances was recorded. The isotope clearance technique is easy, practical, and has this essential advantage in childhood that it does not require exact collection of urine and determination of minute diuresis. Radiation load is negligible. (Abstr. Bulg. Sci. Med. Lit.)

24450 GASTRIC BLOOD FLOW MEASURED BY ^{133}Xe CLEARANCE METHOD. Inous, K.; Tamada, T.; Usui, T.; Ohitsuka, K.; Yamaya, S. (Yokohama City Univ., Japan). Yokohama Igaku; 24: No. 5, 317-322(Oct 1973). (In Japanese).

It is recognized that the healing of gastric ulcer has a tendency of prolongation in elderly patients and it is considered that the decrease of gastric blood flow relates to the disturbance of the healing of gastric ulcer. From this standpoint, experimental studies were carried out on the gastric blood flow and oxygen uptake of gastric mucosa in rabbits to evaluate the difference between normal and experimental arteriosclerotic rabbits. Twenty-one rabbits were studied; 7 rabbits were normal control subjects, 14 were arteriosclerotic rabbits treated with lanolin feeding (2 g/kg/day) and epinephrine administration (2 γ/kg/day). The gastric blood flow was measured by the Kety-Schmidt method using ^{133}Xe (Xenisol-133) intra-arterial and subserous injection. Results were as follows: the transit time of ^{133}Xe clearance curve was 5.9 min. (intra-arterial), 6.4 min. (subserosa of corpus) and 6.3 min. (subserosa of pylorus) in the arteriosclerotic group. In the control group these values were 5.2, 5.2, and 5.3. The mean transit time was prolonged in the group treated with lanolin and epinephrine, namely, the gastric blood flow was decreased in arteriosclerotic rabbits as compared with the control ones. Thus, it was supposed that there could be a causal relation between prolongation of healing of the gastric ulcer in elderly patients and decrease of blood flow of stomach with arteriosclerosis. (auth)

24451 CONTINUOUS RENAL SCINTIGRAPHY OF NEONATE. Concerning the Diagnostic Meaning. Tsuru, N.; Arihiro, H.; Takashima, S.; Watanabe, K. (Kyushu Univ., Fukuoka). Shonika Rinsho; 27: No. 3, 244-249(Mar 1974). (In Japanese).

The diagnostic meanings of the continuous scintigraphy of the kidney of neonate are discussed and four cases of neonate reported. The detector was placed so that the patient lay on it in a supine position. Milk and sedatives were given for pretreatment. From 100 to 200 Ci ^{131}I-hippuran diluted to about 1 ml was injected intravenously. In the normal kidneys, the accumulation of the radioisotopes was observed in both kidneys in 1 to 2 minutes after injection, and they appeared in the bladder after 6 to 7 minutes. The retention in the bladder was observed with the decrease of the level in the kidneys. The following four cases showed these features of scintigraphy; Case 1 (0 day after birth, male) of hematoma of the retroperitoneum; Case 2 (28th day, male) of Rubinstein-Taybi syndrome; Case 3 (1st day, female) of low weight at birth and polycystic kidney disease in the left kidney; Case 4 (2nd day, male) of intracranial bleeding, hematoma of the galea, bilateral hydronephrosis, and infectious disease of the urinary tract. In Case 2 and 3, no pelvic shadow was obtained in the IVP which was carried out on suspicion of malformation of the kidneys, and then the scintigraphy was carried out. In Case 4, the scintigraphy was carried out to examine the conditions of the excretion with time, and the functions of both kidneys were observed. In addition, it was pointed out that hippuran shows little pharmacological effect to be negligible because of the injection of a tracer dose and the prompt excretion and that the exposure dose to the kidneys is less than ^{203}Hg-chlormerodrin. Therefore, this method seemed to be a useful one for adjunct diagnosis of neonate, since there are no need for bowel gases to be removed and the shape of the kidneys can be determined, although the resolution is poor. (JA)

24452 MEASUREMENT OF BLOOD TSH WITH RADIOIMMUNOASSAY KIT AND ITS CLINICAL APPLICATION. Miyoshi, M.; Takehisa, Y.; Suzuki, S. (Okayama Univ., Japan). Horumon To Rinsho; 21: No. 11, 1187-1191(Nov 1973). (In Japanese).

The kit consisting of standard HTSH, ^{125}I-labeled HTSH, antihuman TSH rabbit serum, HCG (100 units/ml), second antibody (antirabbit γ-globulin goat serum), and three types of buffer was used. A test tube containing 0.1 ml each of the standard TSH or sample, HTSH antiserum, HTSH-^{125}I, and HCG and 0.5 ml of buffer (1%BSA) was allowed to stand for 4 days at 4°C. After adding 0.1 ml of the second antibody, the tube was allowed to stand for 24 hours at 4°C, and after centrifugation, the radioactivity of the precipitate was counted to obtain the TSH level from the standard curve. Subjects for measurement were 40 normal individuals, 20 patients with hyperthyroidism, 9 with hypothyroidism, and 36 with chronic thyroiditis and others. At the time of visit to the outpatient department, or at fasting in early morning for inpatients, blood-sampling was performed and the serum was separated for measurement after freeze preservation at −20°C. The measurable limit by the present method was 2.0 μV/ml and the normal upper limit was 10 μV/ml. The mean of 11 measurements of normal individuals' sera was 5.9 ± 1.7 μV/ml. All cases of hyperthyroidism were below the lower measurable limit. The value was high in 52% of the patients with chronic thyroiditis with euthyroid. TSH reaction to TRH was frequently delayed and excessive even if the TSH of the basal level was high or normal. The TSH value in TRH tolerance test was 15 to 27 μV/ml by the intravenous injection of 500 μg of TRH. TSH values in the TRH test in various diseases in control patients were shown. (JA)

24453 RADIOIMMUNOASSAY FOR ESTRONE, ESTRADIOL-17 BETA AND ESTRIOL IN URINE AND AMNIOTIC FLUID. Makino, T.; Kambegawa, A.; Kokubu, T. (Teikoku Hormone Mfg. Co., Ltd., Kawasaki, Japan). Nippon Naibumpi Gakkai Zasshi; 50: No. 4, 788-796(Apr 1974). (In Japanese).

Radioimmunoassay for estrone (E_1), estradiol-17 (E_2) and estriol (E_3) in human urine and amniotic fluid is described. A sample volume of 0.002 to 4.0 ml was used for the assay. As indicators, each tritiated estrogen of glucuronides, dominant conjugates in urine and amniotic fluid, was added to the samples to correct for procedural losses. Conjugated estrogens of glucuronide (G) and sulfate (S) type were hydrolyzed with 15 vol% HCl at 100°C for 60 minutes, and resulting free estrogens were extracted with ether. The dried extracts were applied to microcolumns of Sephadex LH-20, then E_1, E_2 and E_3 were separated by eluting with benzene-methanol (80:15) mixture. A ½ aliquot of the eluate was used for measuring recovery of the added tracer, and the remainder after being added with tritiated free estrogen was dried and incubated with the antiserum in a dilution of the borate buffer (pH 8.0) containing 0.06% bovine serum albumin (BSA) and 0.05% bovine gamma globulin. The free and

bound steroids were separated by 50% $(NH_4)_2SO_4$, and tritium activities in the supernatant were counted. The antisera used for the assay were E_1-17-BSA for E_1, E_2-6-BSA for E_2 and E_3-6-BSA for E_3, which had been prepared by us. In urine, all recoveries were 65.0 ± 5.6 (mean ± S.D.)% for E_1-3-S, 68.8 ± 7.2% for E_1-3-G, 64.5 ± 5.8% for E_2-17β-G and 41.1 ± 9.1% for E_3-16-G. In amniotic fluid, the recoveries were almost equal to those of the urine. Water blank in each estrogen assay was about 4 pg/sample. Accuracy and precision of the method were satisfactory. The results determined by this radioimmunoassay were in good correlation with those determined by Brown's colorimetry at high estrogen concentration in urine. As this method is accurate and highly sensitive, we can determine estrogen values of low level or with small assay volume in both urine and amniotic fluid. (auth)

24454 CURRENT STATE OF AUTOMATION OF RADIOIMMUNOASSAY TECHNIQUES. Ingrand, J.; Linhart, N.; Roucayrol, J. C. (Hospital Cochin, Paris). J. Biol. Med. Nucl.; 9: No. 35, 22-41(1974). (In French).

In the first part, a brief analysis is given of some apparatus available in radioimmunoassay laboratories. Both semiautomatic systems intended for confirmed and less well confirmed radioimmunoassay methods, and equipment having more modest performances but capable of being adapted to different measurements, are presented. In the second part, the experience acquired in the field of automating radioimmunoassay plasma insulin measurements is discussed. The components of the automatic systems are described. The advantages and disadvantages are analyzed. (FR)

24455 PERFUSION LUNG SCANNING USING ^{99m}Tc-ALBUMIN MICROSPHERES. Isawa, T.; Okubo, K.; Shiraishi, K.; Matsuda, A.; Konno, J. (Tohoku Univ., Sendai). Nippon Kyobu Rinsho; 33: No. 5, 307-312(May 1974). (In Japanese).

The ^{99m}Tc-albumin microspheres were prepared at the laboratory using "3M albumin microsphere ^{99m}Tc labeling kit" and used clinically for perfusion lung scanning. Neither objective nor subjective untoward reactions were noted and lung function was unaltered following intravenous injection of the pharmaceutical. There was no significant difference in scan images and perfusion partition ratios to the right and left lungs between ^{99m}Tc-albumin microspheres and ^{131}I-MAA. Tagging efficiency of $^{99m}TcO_4^-$ was 61% on the average, and there was about 5 to 8% free or unbound $^{99m}TcO_4^-$ in the solution of ^{99m}Tc-albumin microspheres. The low yield and the presence of unbound $^{99m}TcO_4^-$ remain to be improved. (auth)

24456 AUTOMATIC PROCESSING OF SCINTIGRAPHIC DATA USING DUAL ISOTOPE TECHNIQUE. Application to Pancreatic Views. Soussaline, F.; Di Paola, R.; Bok, B. (Institut Gustave Roussy, Villejuif, France). Ann. Phys. Biol. Med.; 7: No. 4, 189-204(1973). (In French).

The use of a dual isotope technique is of great interest in the enhancement of scans: a subtraction procedure enables such an improvement. The method described allows a dual isotope technique with a rectilinear scanner. Digitized data are collected on a compatible incremental magnetic tape recorder. Processing and visualization are realized with the use of a small computer system. Conversational mode is widely used between man and computer as well for the value of the two parameters, i.e.: amount to be subtracted, normalization of the definitive view, as for the different processing for the scans. Such a method gave fairly good pancreatic views, with Selenomethionine and Tc-sulfur colloid. The method is characterized by its versatility, enabling new examination techniques, and pre- and post-subtraction scans processing as well as the optimization of the subtraction parameters. (FR)

24457 EFFECTS ON DIETARY CALCIUM AND PHOSPHORUS LEVELS ON ZINC ABSORPTION AND TURNOVER IN THE CHICK. Saito, M.; Matsumoto, T. (Tohoku Univ., Sendai). Nippon Chikusan Gakkai-Ho; 44: No. 11, 554-558(Nov 1973). (In Japanese).

Fifty-four White Leghorn male chicks were divided into 9 groups at 14 days of age and were fed 9 different kinds of chick starters containing one of the combinations of 3 levels of calcium, i.e., low (0.5%), normal (1.1%) and high(1.6%) calcium and 3 levels of phosphorus, i.e., low(0.42%), normal(0.62%) and high(0.9%) phosphorus. At 20 days of age, the chicks were administered orally or were injected intramuscularly with $^{65}ZnCl_2$, and ^{65}Zn absorption and turnover were examined. The higher the dietary phosphorus level was, the more significantly ^{65}Zn absorption was reduced by the increase of calcium level. The more the diet contained calcium, the more greatly ^{65}Zn absorption was affected by the phosphorus content. The retention curves for orally administered ^{65}Zn were resolved into 2 linear components and the biological half-life of each component was calculated. The first component represented primarily the passage of ^{65}Zn through the digestive tract and its subsequent loss in the feces. The second component showed the excretion of ^{65}Zn which had been absorbed from the intestine into the body. A highly significant positive correlation ($\gamma = 0.981$) was observed between the percentage absorption of ^{65}Zn and the biological half-life of the first component. On the other hand, a highly significant negative correlation ($\gamma = -0.978$) was observed between the biological half-life of the first component and that of the second component. These observations clearly demonstrate that both high dietary calcium and phosphorus hasten the passage of zinc through the digestive tract and consequently they reduce the absorption of zinc from the intestine. (auth)

24458 RADIOISOTOPE DIAGNOSIS OF INCOMPETENCY OF THE COMMUNICANT VEINS AND VENOUS THROMBOSIS OF THE LOWER EXTREMITIES AND PELVIS. Zhukov, B. N. Vestn. Khir.; 11: 47-50(Jul 1973). (In Russian).

An analysis of observations over 136 patients suffering from thrombophlebitis of the lower extremities and pelvis is presented. A new method of radioisotope diagnosis of the perforating veins incompetency is described. The data obtained are compared with phlebotonometry, venography, and operative findings, the data of the functional state of the coagulation and fibrinolytic blood systems in the general and regional blood flow. Incompetency of the communicant veins was revealed by means of this method not infrequently in early stages of the disease in 34 observations. No complications in the process of this investigation were noted. (auth)

24459 RADIOCHOLECYSTOGRAPHY IN APPRAISING THE MOTOR FUNCTION OF THE GALLBLADDER. Sivkov, I. I.; Rubin, M. P.; Prokhorov, V.; Troschilo, O. D. (Moscow Medical Inst.). Sov. Med.; 36: No. 5, 73-78(Aug 1973). (In Russian).

Radioisotope methods allow a strict quantitative evaluation of the gallbladder contractions to be made. The features characterizing the motor function of the gallbladder in normalcy, in different forms of dyskinesia, and dyskinetic cholecystitis are given and methods of their determination are described. The most important characteristic of the gallbladder is the mean relative rate of bile elimination from this organ. (auth)

24460 SKELETAL SCINTISCANNING WITH ^{75}Se SODIUM SELENITE. Smaltino, F.; Bernini, F. P. (Policlinico, Naples). Radiol. Med.; 60: No. 2, 127-133(Feb 1974). (In Italian).

Results obtained with ^{75}Se-sodium selenite scintiscanning in 27 cases of primarily osteolytic bone lesion are presented and 5 illustrative cases are described. (auth)

24461 LIVER FUNCTION EXAMINATIONS USING ^{131}I-ROSE BENGAL SCANNING EXPERIENCES IN 4000 CASES. Udvardy, L. Magy. Radiol.; 26: No. 4, 214-223(Aug 1974). (In Hungarian).

The liver isotope examinations performed by the author during 12 years in 4000 patients with liver diseases are reported. The functional examinations have been carried out with ^{131}I Bengal rose (no scintigrams were made). On the basis of isotope examinations performed in various liver diseases it has been found by the author, that the liver isotope examinations are considerably more sensitive than the conventional laboratory examinations performed as yet. Biopsy is not rendered unnecessary by the ^{131}I Bengal rose test, but in certain cases, with observation of the so-called constellations, it is suitable for the differentiation of the liver diseases. In the examination of intrahepatic or extrahepatic occlusions the method is a reliable procedure, so much so more as minimal radiation loading occurs, and no drawing of blood or duodenal probing is necessary. (auth)

24462 VALUE OF THE SCINTIGRAPHIC EXAMINATION OF TUMORS OF THE SALIVARY GLAND. Szabo, G.; Csernay, L. Magy. Radiol.; 26: No. 4, 233-239(Aug 1974). (In Hungarian).

On the basis of the scintigraphic examination of 52 tumors of the salivary gland and of those observed in the vicinity of the salivary glands, the advantages of this method found in establishing more proper preoperative diagnosis are discussed. By means of mobile detector, gamma camera, and examinations performed with multichannel analyzer it may be determined whether the tumor has started from the salivary gland or from its environment. The isotope concentration of the tumor allows, between certain limits, conclusions with respect to the histological structure of the tumor. (auth)

24463 METHOD OF RADIOISOTOPE STUDY OF SEPARATE SEGMENTS OF THE SMALL INTESTINE ABSORBING CAPACITY. Kosharko, K. A.; Volkov, D. M.; Nalivkina, A. I.; Tel'nov, Yu. A. (Voronezh Medical Inst., USSR). Med. Radiol.; 19: No. 8, 17-20 (Aug 1974). (In Russian).

The application of the modified method after Hemmati (1968) for local controlled introduction of marked compounds into different parts of the small intestine with the aim of studying the intensity of absorption is discussed. The study was made in 153 volunteers of both sexes at the age of 18 to 50 years with the help of RISA-^{131}I introduced into different parts of the intestine. (auth)

24464 RADIOISOTOPESCANNING AND ELECTRIC ROENTGENOGRAPHY OF MALIGNANT TUMORS OF THE ACCESSORY SINUSES AND THE NASOPHARYNX. Gorskii, L. A.; Prikhod'ko, A. G.; Gabuniya, R. I.; Vorob'ev, Yu. I. (Scientific-Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 19: No. 8, 14-17 (Aug 1974). (In Russian).

Scanning of malignant tumors of the maxillary-facial region with ^{75}Se-methionine was made in parallel to electroroentgenography (xeroradiography) of the accessory sinuses and the nasophyrynx. Roentgenograms were made on selenium plates in direct and lateral projections with a focal distance of 2 m. Under such conditions magnification of the accessory sinuses was minimum owing to which it was possible to make an accurate matching of scannographic and electroroentgenographic images. A positive image of a malignant tumor caused by an increased accumulation of ^{75}Se-methionine in it was distinctly projected on the anatomical formations of the facial skeleton. Results of examination of a patient with carcinoma of the Highmour sinuses mucosa and a female patient with cancer of the nasopharynx are given as examples. Radioisotopescanning and electric roentgenography of malignant tumors of the accessory sinuses and the nasophyrynx with the employment of ^{75}Se-methionine is a valuable additional method of examination that combines advantages of scannography with those of roentgenological examinations. (auth)

24465 STUDY OF PANCREAS WITH THE HELP OF RADIOINDICATION METHODS. Gabuniya, R. I.; Klimanov, M. E.; Soshin, L. D.; Tsyplyaev, V. A.; Kuz'min, V. P.; Gorskii, L. A. (Scientific-Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 19: No. 8, 10-14(Aug 1974). (In Russian).

The pancreas was studied with methionine-^{75}Se in 43 patients using the method of scintigraphy in a γ chamber. A detailed description of the method is presented. A normal image of the pancreas was obtained in 25 patients and pathology was observed in 18 patients. An intact pancreas is characterized by a high level of preparation accumulation, a clear contrast of the image, distinct outline, and even distribution of the preparation. In cases of chronic pancreatitis, as a rule, a more close ajoining of the gland to the liver was observed; all the parts of the organ were badly contrasted, the outlines were indistinct and the distribution of the preparation not even. A scintiphotographical image of the pancreas tumor was characterized by the presence of defects in the inclusion of the preparation, deformation of the gland outline. Carrying out of scintigraphy with the use of the γ chamber makes it possible to obtain additional information about the pancreas condition. (auth)

24466 DETERMINATION OF RENAL CLEARANCE IN RADIOISOTOPE RENOGRAPHY. Meldolesi, U.; Conte, L.; Mombelli, L.; Roncari, G. (Univ., Milan). Radiol. Med.; 60: No. 2, 149-160(Feb 1974). (In Italian).

A method for determining the fractional clearance of the radiocompound used for renography is presented. A relationship of proportionality between the fractional clearance and the clearance corrected to the body surface area was demonstrated, by means of which the latter can be estimated with a standard error of 10%. (auth)

24467 STUDY OF AGING AND FUNCTIONS OF RETICULOENDOTHELIAL SYSTEM. Experiment by Intravenous Injection of Radioisotope ^{59}Fe Chondroitin Sulfuric Acid Colloid. Watanbe, Y. (Tokyo Medical Coll.). Yokohama Igaku; 31: No. 6, 917-950(Nov 1973). (In Japanese).

Fundamental experiments for examination of the relationship between aging and functions of reticuloendothelial system by intravenous injection of ^{59}Fe chondroitin sulfuric acid colloid (c-Fe), both with animals and clinical cases; old men aged 51 to 83 years, were divided into normal and disease groups. After intravenous injection of 20 mg, 10 c/ml c-Fe, blood samples were taken consecutively at certain time intervals. Plasma samples were subsequently separated into supernatant and precipitate, and the radioactivity of each part was determined. Values for the former represent ^{59}Fe globulinate activity and for the latter ^{59}Fe colloid clearance activity, which means phagocytic activity. After intravenous injection, blood samples were taken for some days to be used for determination of the rate of utilization by erythrocytes of iron originating in c-Fe (% RCV). The same subjects who received c-Fe were separately given 20 Ci ^{59}Fe globulinate, which does not pass through reticuloendothelial system, and % RCV was calculated. From the difference between % RCV for c-Fe and that for globulinate, the theoretical curve was plotted for time lag, which was defined to represent disposal activity of reticuloendothelial system. White male rabbits were divided into 4 groups: young, mature, those with arteriosclerosis, and pretreated reticuloendothelial system group. Experiments were conducted with various doses of c-Fe; radioactivity was measured by the same method as in the clinical experiment, and autoradiography was performed. Males mice were given 0.5 mg/Ci/20 g c-Fe, and organ distribution of c-Fe was observed. c-Fe phagocytic activity of the reticuloendothelial system in old men was shown. Positive correlation was found between plasma ^{59}Fe colloid clearance T $\frac{1}{2}$ and time for appearance of plasma ^{59}Fe globulinate. In the rabbit experiment, c-Fe clearance time was shown in 4 groups. The results showed that function of reticuloendothelial systems undergoes no appreciable change with aging as far as its phagocytic activity is concerned, but its disposal activity is diminished with aging. In the presence of some blood diseases or abnormality of reticuloendothelial system, both phagocytic and disposal activity decline, but not in a parallel manner. (JA)

24468 RADIOIMMUNOASSAY FOR SERUM 11-DEOXY-17-KETOSTEROIDS. Sekihara, H.; Ohsawa, N. (Tokyo Univ.). Steroids; 23: No. 2, 245-258(Feb 1974).

A simplified method for evaluating serum 11-deoxy-17-ketosteroids (11-deoxy-17-KS) equivalent to dehydroepiandrosterone sulfate (DHEAS) has been developed without solvolysis and chromatography. 5 μl of serum or plasma was added to 1 ml of ethanol, mixed, and centrifuged. 10 or 20 μl of the supernatant was evaporated to dryness and incubated with anti-11-deoxy-17-KS antiserum obtained by immunizing a rabbit with DHEA-3,0·CO-BSA which was prepared from DHEA-3,0·COCl and containing DHEAS-7α^3H, pepsin-treated human immune serum globulin and bovine serum albumin. Ammonium sulfate was used to separate free from bound DHEAS-7α^3H. The accuracy, precision, and sensitivity were satisfactory. The blank values could not be differentiated from zero. As the antiserum reacted not only on DHEAS but also on androsterone sulfate and etiocholanolone sulfate, serum 11-deoxy-17KS obtained by the radioimmunoassay expressed nearly the sum of 100% of DHEAS, 45% of androsterone sulfate and 35% of etiocholanolone sulfate in the serum. A good correlation was found between serum 11-deoxy-17-KS and DHEAS obtained by the radioimmunoassay described in a previous paper. The present radioimmunoassay is the simplest method for the evaluation of the concentrations of C_{19} steroids in the serum. (auth)

24469 STUDIES IN CALCIUM ABSORPTION: INITIAL ENTRY OF CALCIUM INTO THE GASTROINTESTINAL TRACT IN HYPERPARATHYROIDISM AND IN A CASE OF RENAL TUBULAR ACIDOSIS. Barzel, U. S.; Hart, H. (Montefiore Hospital and Medical Center, Bronx, NY). Nephron; 10: 174-187(1973).

Gastrointestinal (GI) absorption of radiocalcium was measured by the application of a computerized deconvolution technique to data obtained by external arm counting. When compared to normals, hyperparathyroid subjects displayed an exaggerated rate of initial entry of calcium into the GI tract. Total tracer absorbed was also increased. A similar increase in the rate of initial entry of calcium and total calcium absorbed from the GI tract was found in a non-hyperparathyroid subject with distal tubular acidosis of the adult type. It is concluded that in addition to the abnormal function of renal tubular cells in the handling of hydrogen ion there may be in this case, and possibly in others with renal tubular acidosis, an abnormality in the handling of calcium by the GI cells. (auth)

24470 PEG TEST: A NEW RADIOIMMUNOASSAY FOR THE DETECTION OF HEPATITIS B ANTIGEN. Lambert, P. H.; Tribollet, E.; Knoepfel, M.; Madalinski, K.; Miescher, P. A. (Hospital Cantonal, Geneva). Schweiz. Med. Wochensch.; 104: No. 4, 128-129(Jan 1974).

A new radioimmunoassay for hepatitis B antigen (HBAg) is described. Test sera are mixed with ^{125}I-Fab fragments isolated from purified anti HBAg antibody. Free ^{125}I-Fab was separated from HBAg-bound ^{125}I Fab by precipitation with polyethylene glycol (PEG) at 10%. This method proved very sensitive and applicable to the detection of HBAg even in presence of antibody excess. It is not susceptible to the effect of anti-Fe antiglobulins. (auth)

24471 CEREBRAL SCINTISCANNING WITH ^{99m}Tc IN THE EXAMINATION OF ISCHEMIC CEREBROVASCULAR LESIONS. D'amico, P.; Tagliabue, M. (Ospedale S. Gerardo, Milan). Radiol. Med.; 60: No. 2, 134-148(Feb 1974). (In Italian).

The ^{99m}Tc cerebral scintiscan pictures in 282 subjects with ischemic cerebrovascular lesions are compared with the neurological data, the clinical course, and the electroencephalography and angiographic findings. (auth)

24472 NUCLEAR LABELLING AFTER PROLONGED ^{3}H-URIDINE INCORPORATION AS VISUALIZED BY HIGH RESOLUTION AUTORADIOGRAPHY. Fakan, S.; Bernhard, W. (Institut Suisse de Recherches Experimentales sur le Cancer, Lausanne). Exp. Cell Res.; 79: 431-444(Jun 1973).

Localization of radioactive labelling over the nuclei of BSC_1 cells is visualized after long periods of ^{3}H-5-uridine incubation followed or not followed by periods of postincubation in non-radioactive medium for up to several days, using high resolution autoradiography combined with a preferential staining method for ribonucleoproteins. It is shown that when cells are labelled for 1 or 6 h with ^{3}H-uridine and postincubated with a non-radioactive medium up to several days, there is always some radioactivity present in the nucleolus and nucleoplasm. When sections of cells fixed after 1 h of labelling followed by 24 h of postincubation are treated with RNase, part of the radioactivity found in the nucleus disappears almost completely only after a succeeding DNase digestion. The majority of interchromatin granules are weakly labelled after most incubation times, with the label localized rather at the periphery of clusters of granules, or are unlabelled. The results are discussed in the context of recent biochemical findings. It is proposed that interchromatin granules might represent a structure containing a limited quantity of slowly labelled nuclear RNA. (auth)

24473 AN INTRODUCTION TO NUCLEAR MEDICINE. Mandell, C. H. (Rhode Island Hospital, Providence). R. I. Med. J.; 57: 97-99(Mar 1974).

The development of nuclear medicine is briefly reviewed with emphasis on development of radioisotope scanning, radiopharmaceuticals, and the Anger gamma camera. Instrumentation is discussed with regard to scanners, collimators, and photomultiplier tubes. In a discussion of radiation exposure it is pointed out that the use of short half-life radionuclides and more sensitive detection instruments results in greatly reduced patient exposure. Gonadal doses using the new techniques and doses from x-ray procedures are compared. (HLW)

MATERIALS

24474 THERMAL EXPANSION, 1973. International Symposium on Thermal Expansion of Solids Held at Lake of the Ozarks, Missouri, November 7–9, 1973. Taylor, R. E.; Denman, G. L. (eds.). AIP Conference Proceedings, Number 17. New York; American Institute of Physics (1974). 311p. (CONF-731118-).

Twenty-seven papers were presented at the symposium. A separate abstract was prepared for each of five papers selected by NSA scope. Papers for which no abstracts were prepared are concerned with heterogeneous materials, measurement techniques, property correlation, and theory. (JRD)

For abstracts of individual papers see: 24498, 24628, 24629, 24756, and 24757.

24475 CRYSTALLIZATION PROCESSES UNDER HYDROTHERMAL CONDITIONS. Lobachev, A. N. (ed.). Studies in Soviet Science. New York; Plenum Publishing Corp. (1973). 261p. $29.50.

Translated from Russian by G. D. Archard.

Fifteen papers are included in the book. An abstract was prepared for one paper selected by NSA scope. Papers for which no abstracts were prepared are concerned with hydrothermal crystallization, TiO, chalcohalides, antimonite, titanates, calcite, carbonates, sodalite, lithium silicates, germanates, zincogeranates, and hydrothermal equipment design. (JRD)

For an abstract of an individual paper see: 24530.

Ceramics and Cermets

Refer also to abstracts 23592, 23595, 23692, 23748, 24572, 24579, 24584, 24590, 24596, 24611–24616, 24654, 24657, 24670, 24710, 24714, 24734, 24751, 25818, 25824, 25835, 25872, 25873, 25924, and 25989.

24476 (AD-776194/3) EFFECTS OF HEATING ON COLOR CENTERS IN GERMANIUM-DOPED QUARTZ. Anderson, J. H.; Feigl, F. J.; Schlesinger, M. (Lehigh Univ., Bethlehem, Pa. (USA). Dept. of Physics). 18 Mar 1974. Contract N00014-67-A-0370-0009. 17p. NTIS $3.00.

Optical absorption, electron paramagnetic resonance absorption, and thermoluminescence have been measured in germanium-doped quartz crystals which have been x-irradiated at room temperature and subsequently heated. Strong bleaching of the 280 nm optical absorption and the A and C center magnetic resonance absorptions coincided with maxima of the total thermoluminescent glow curve. The temperature at which these several phenomena occurred varied for different quartz samples. (GRA)

24477 (BMI-1622) HIGH-TEMPERATURE IRRADIATION OF URANIUM CARBIDE. Freas, D. G.; Shumaker, P. B.; Stang, J. H.; Gates, J. E. (Battelle Columbus Labs., Ohio (USA)). 6 Mar 1963. Contract W-7405-eng-92. 60p. Dep. NTIS $6.00.

Declassified 31 Aug 1973.

Irradiation of two capsules, BMI-WR-30 and BMI-WR-31, was conducted to establish the in-pile behavior of $UC_{1.08}$ and $UC_{1.45}$ at surface temperatures of about 2400 and 2200°F, respectively. In the irradiation of Capsule BMI-WR-30 the time-temperature-compatibility limitations of $UC_{1.08}$ clad with Nb–1% Zr alloy were exceeded, resulting in the catastrophic failure of the specimens by reduction of UC to form free molten U. Irradiation of Capsule BMI-WR-31 was successful even though the specimens also exceeded the design temperatures. In general, the $UC_{1.45}$ fuel alloy was found to show reasonable resistance to swelling as a function of U burnup up to centerline temperatures of 2300 to 2400°F. The fission-gas-retention properties of this fuel appeared to be favorable up to surface temperatures of about 2250°F, where only 10% of the fission gases produced were released. The compatibility behavior of $UC_{1.45}$ and Nb–1% Zr alloy with respect to surface temperatures between 2100 and 2400°F was inconsistent; i.e., there appeared to be no relation between temperature and the instances of liquid formation or lack of liquid formation. The incorporation of barrier foils of W and Re in the specimens did not prevent carbon diffusion between the fuel and cladding, but apparently did prevent or reduce the tendency for liquid-phase formation. No liquid was observed in any specimen containing a barrier foil in Capsule BMI-WR-31. (31 figures) (auth)

24478 (BMI-1702) DEVELOPMENT OF ADVANCED HIGH-TEMPERATURE NUCLEAR MATERIALS DURING AUGUST THROUGH OCTOBER 1964. Chubb, W.; Paprocki, S. J. (Battelle Columbus Labs., Ohio (USA)). 1 Nov 1964. Contract W-7405-eng-92. 58p. Dep. NTIS $6.00.

Declassified 31 Aug 1973.

At fuel-surface temperatures near 1200°C and burnups of 1 at. % of the uranium, both alloyed and unalloyed uranium carbides showed diameter increases of about 1%. Unalloyed fuels showed appreciable porosity after irradiation, whereas alloyed fuels showed virtually none. Under similar irradiation conditions, fission-gas release from fully dense hyperstoichiometric UC was 0.1 to 0.3%, from 92% dense UC it was 2.7 to 3.9%, and from 87% dense UC it was 5.2 to 7.4%. All specimens showed fuel-diameter increases of 1.4% or less. At fuel-surface temperatures near 1100°C and burnups of approximately 1 at. % of the uranium, UN, UC alloys, and tungsten–UC cermets showed negligible cladding outside-diameter changes. The rate of reaction of hyperstoichiometric UC with W–Re alloys was found to be a function of their Re content at 1500°C and below. A W foil barrier was effective in retarding the accelerated reaction between hyperstoichiometric UC and W–Re alloys. An indication was obtained that UC–TaC alloys are more compatible with Ta than in unalloyed UC. Liquid copper was successfully contained in sealed molybdenum capsules for 500 h at 1600°C. A ternary-phase field containing UO_2, W, and a tungsten "bronze" (U_xWO_3) was identified on the high-oxygen side of the UO_2–W tie line. These three phases react to form a molten ternary eutectic between 1300 and 1430°C. The heat of formation of UC_2 at 298°K was redetermined and found to be –20 kcal per mole. Calculations which consider the effects of fuel swelling upon the size and weight of a compact 1-MW(e) reactor operating above 1100°C with UC as a fuel suggest that optimum enrichment decreases as temperature and pin size increase. When UO_2 was irradiated in a heavy-walled Nb–1% Zr cladding at surface temperatures near 1200°C, no swelling of the cladding was observed, but the UO_2 tended to redistribute itself, largely, by vapor transport, as a layer of nearly uniform thickness over the inside surface of the cladding. (30 figures, 13 tables) (auth)

24479 (BMI-1848) DEVELOPMENTS IN THE TECHNOLOGY OF NUCLEAR FUELS DURING AUGUST 1967 THROUGH JULY 1968. Annual Report. Keller, D. L.; Chubb, W. (Battelle Columbus Labs., Ohio (USA)). 1 Aug 1968. Contract W-7405-eng-92. 225p. Dep. NTIS $14.25.

Declassified 4 Sep 1973.

Saturation swelling was observed in UN, W–UN cermets, and W–UO_2 cermets. When they are irradiated near 1700°C, volume increases of 20 to 40% are observed at burnups near 1×10^{20} fissions per cm^3; however, the rate of volume increase is negligible or ceases altogether at higher exposures. UC and W–UC cermets also show a trend toward decreasing swelling rates after volume increases of 20 to 40%, but swelling continues at a significant rate. The volumetric swelling rates of dense UC and UN cermets are nearly identical to those of the corresponding dense bulk fuels at the same fission density. Porosity in the irradiated UC is largely in the form of discrete spherical bubbles, whereas the porosity in the UN is largely in the form of elongated, interconnected channels. Considerable transport of UN by sublimation was observed. This may be responsible for the differences in gas release between UC and UN and for the more pronounced saturation swelling in UN. The UO_2 cermets also show vapor transport and redistribution of UO_2 within their claddings. Attempts to obtain saturation of swelling at the beginning of an irradiation by duplicating the postirradiation structure were successful. The introduction of a 0.055-in. axial hole, removing about 7 vol % of the fuel, decreases the swelling rate at 1700°C of fuels (UO_2–W and UN) which are relatively mobile in terms of vapor transport and which are believed to possess high rates of gas release. This decrease cannot be attributed only to the ability of the cladding to direct swelling toward the axial center or ends of the fuel since the hole was not consumed. The introduction of a 0.055-in. axial hole into UC produces no change in its swelling behavior at 1700°C. The introduction of a 0.110-in. axial hole into UC, removing 27 vol %, increases the rate of external swelling by increasing the gas generation rate in the remaining fuel. The observed behavior is correct if there is essentially no restraint from the cladding and if essentially no gas is released from the UC. Thus, the gas bubbles should swell the UC as if it were expanding from thermal expansion with a temperature rise. The specimens with the largest hole contain the same total amount of fission gas in a smaller volume of fuel; hence, they expand more. Doubling the thickness of the cladding on 98% dense UN specimens containing a 0.055-in. axial hole decreases (25%) in the external swelling of this fuel at 1700°C, less than expected. The behavior of two 72% dense W–UO_2 cermets, one vented to the capsule and the other sealed, suggests that the total amount of gas generated and released is in-

sufficient to deform the cladding. This result suggests that a vent is superfluous in addition to 28% interconnected porosity and a small gas plenum. This result in conjunction with the observation that UN specimens with similar claddings swelled about 5% radially while the unvented UO_2 cermet swelled less than 1% further indicates that the large swelling in other fuels is caused by swelling of the fuels and that the contribution of released gas to swelling of the cladding is negligible. Variations of the model which includes gas release and loss of mechanical strength of the fuel during irradiation indicate that gas release dominates the amount of swelling. UO_2 vented to internal gas plenums showed large swelling at surface temperatures from 1700 to 1500°C. At a burnup of about 1.9×10^{20} fissions per cm^3, two specimens with 0.110-in. axial centerline holes swelled about 20 vol %, whereas two specimens with metal tubing lining a tapered axial hole swelled about 6 to 12 vol %. All have essentially the same total void volume within their claddings and none are vented to the capsule. The gas release from UC containing the gas in metastable solution is being compared with the release of gas from UC in which the gas has been precipitated by annealing. A decrease of more than an order of magnitude at an exposure of 1.1×10^{13} fissions per cm^3 suggests that the anneal is precipitating most of the gas. It is estimated that 2×10^{-13} to 16×10^{-13} atom fraction of fission gas is soluble in UC at 1600°C in vacuum. It was demonstrated that under near-boiling conditions, voids in a liquid-metal column tend to collect at the point of maximum temperature so as to equalize vapor pressures at both ends of the void. A capillary pump such as is used in a heat pipe is suggested as a solution to the problem. (130 figures, 40 tables) (DLC)

24480 (CEA-CONF-2621) EQUILIBRIUM DIAGRAM OF PHASES IN THE Gd_2O_3–Ga_2O_3 SYSTEM. Allibert, M.; Chatillon, C.; Mareschal, J.; Lissalde, F. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 5 Dec 1973. 11p. (In French). (CONF-730994-3). Dep. NTIS (US Sales Only) $4.00.

From conference on magnetic bubbles; London, England, UK (4 Sep 1973).

The phase diagram of the Gd_2O_3–Ga_2O_3 system was determined in the vicinity of the composition 3 : 5 by mass spectrometry and x-ray diffraction. The gaseous species present above the condensed phases and their evolution during evaporation were studied with a Knudsen effusion cell in the temperature interval from 1500 to 2000°K. This made it possible to determine some thermodynamic data and the phase limits. The results were compared with those deduced from an x-ray diffraction study. (tr-auth)

24481 (CEA-R-4572) MEASUREMENT OF THE THERMAL DIFFUSIVITY OF MIXED URANIUM AND PLUTONIUM OXIDES. Effects of Stoichiometry and Plutonium Content. Weilbacher, J. C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). Apr 1974. 119p. (In French). Dep. NTIS (US Sales Only) $9.00.

Thesis. Submitted to Paris Univ.

The effects of three parameters (temperature, stoichiometry, and plutonium content) on the high temperature thermal diffusivity of mixed (U Pu)O_2 oxides were studied. The work included three different parts: a device has been built to allow thermal diffusivity measurements under controlled atmosphere in a large temperature range (700 to 2750°C); measurements of the thermal diffusivity of (U Pu)O_2 have been performed; the experimental results have been interpreted on the basis of lattice and electronic conduction mechanisms and vacancy effects. (FR)

24482 (COM-74-10472/0) NBS MATERIALS SCIENCE AND MANUFACTURING IN SPACE RESEARCH. Final Report, 1 November 1972–31 October 1973. Passaglia, E.; Parker, R. L. (National Bureau of Standards, Washington, D. C. (USA)). Nov 1973. Contract NASA-W-13475. 129p. (NBSIR-73-402). NTIS $9.50.

Topics studied included: effects of convection on crystal perfection in Czochralski crystal growth; vapor transport synthesis and crystal growth of oxides; preparation of ultrahigh purity material; role of surface traction and related phenomena in chemical processing in space; and vacuum effects in the preparation of composite materials. (GRA)

24483 (CONF-740724-2) RELATION BETWEEN RADIATION-INDUCED AND THERMAL PRIMARY CREEP TO STEADY STATE CREEP IN UO_2. Solomon, A. A. (Argonne National Lab., Ill. (USA)). 1974. 21p. Dep. NTIS $4.25.

From symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (Jul 1974).

Elevated temperatures and radiation-induced primary creep is shown to be an important and general phenomenon in UO_2 and (U,Pu)O_2. The existence of steady-state creep has not been conclusively established. Analysis of primary and secondary creep reveals a general difficulty in obtaining steady-state creep and suggests that the time dependence of primary creep should be analyzed before assuming that the steady state has been obtained. Generally, creep tests on ceramics are conducted with several possible experimental constraints or limits, e.g., time, strain, or maximum strain rate change. The errors introduced in the analysis of primary creep were shown to be significant. Since steady-state creep was not generally attained, no assessment of error was possible. The importance of primary creep in oxide fuels and possibly other ceramics introduces complexity into many related phenomena and analyses. Hot-pressing, fracture, and thermal shock behavior are affected. The engineering use of ceramics generally implies small strains where primary creep is important. The prediction of behavior via deformation maps becomes much more complex because the time dependencies of the different mechanisms may be different and will have to be determined accurately to predict the behavior of metals and ceramics. (auth)

24484 (EUR-4671) SOME EXPERIMENTAL RESULTS ON THE FISSION-INDUCED LOSSES OF URANIUM FROM SURFACES OF UO_2 AND U IN PRESENCE OF H_2O AND LIQUID Na. Gautsch, O.; Kestemont, L. (Commission of the European Communities, Brussels (Belgium)). 1971. 14p. INIS.

Samples of U and UO_2 were irradiated with thermal neutrons in presence of either H_2O or liquid Na to determine the fission-induced losses of U from the surfaces. Results show that due to the passage of fission fragments, a surface layer is formed which badly adheres to the bulk. Such layers or parts of it can easily be rubbed off by means of Al foils pressed against the surface. They can also be dissolved by chemical agents which in absence of radiation does not etch the surfaces. In case of H_2O, the radiolytically produced radicals react with the UO_2 and the amounts of U dissolved increase with increasing thermal flux and irradiation time. After a given irradiation time, the reaction rate becomes constant because a constant saturation concentration of the radicals in the H_2O is reached due to recombination. In the case of liquid Na, which does not form radicals, the U losses are mainly caused by some kind of interaction between the Na and UO_2, which is due probably to a radiation-induced chemical reactivity of the surface. The results of the U losses showed a large scattering; therefore it was not possible to know the influence of the thermal neutron dose and the type of process by which the losses occur. (INIS)

24485 (EUR-5078) SELF-DIFFUSION OF URANIUM IN URANIUM MONOCARBIDE. Evaluation of Curved Arrhenius Diagrams. Matzke, H.; Tasman, H. A. (Commission of the European Communities, Brussels (Belgium)). Feb 1974. 52p. INIS.

A curved Arrhenius plot was observed for uranium diffusion in stoichiometric UC. For an optimal evaluation, either two separate or the sum of two exponentials were fitted to the experimental data. For the latter case, an iterative procedure showed that the standard deviation sigma is rather insensitive to considerable variations in slopes and intercepts. Acceptable results are obtained, however, with a minimization of sigma while varying one or two of the parameters steps and adjusting the remaining parameters. The resulting equation for the diffusion of U in UC is $D = 6.9 \exp(-141.00/RT) + 3.6 \times 10^{-5} \exp(-84{,}500/RT)$ $cm^2\ sec^{-1}$. Results are discussed on basis of the present knowledge of nontrivial curved Arrhenius diagrams (so far observed mainly for metals, alkali metal and silver halides). Different possible mechanisms are discussed. As a plausible reason for the curvature, a single-vacancy mechanism is suggested at low temperatures, whereas a divacancy mechanism is said to dominate at temperatures near the melting point (2085-2545°C). The present knowledge on carbides does, however, not suffice to definitely exclude other alternatives. As the most probable alternative, the effect of impurities by providing impurity–vacancy interaction is suggested. Finally, the evaluation procedure was applied to curved Arrhenius plots on other systems. (auth)

24486 (IS-T-635) MOESSBAUER EFFECT STUDY OF ^{57}Fe IN TRANSITION METAL SEMIBORIDES AND TWO-DIMENSIONAL FERROUS CHLORIDE COMPLEXES. Schurter, J. L. (Ames Lab., Iowa (USA)). Jul 1974. Contract W-7405-eng-82. 88p. Dep. NTIS $7.50.

Thesis.

The nuclear hyperfine properties of $(CH_3NH_3)_2FeCl_4$ and $(C_6H_5CH_2NH_3)_2FeCl_4$ were studied by Moessbauer effect spectroscopy. The effective hyperfine fields as a function of temperature were determined by transmission experiments using powdered samples. Isomer shifts and quadrupole splittings were also determined. Methylammonium ferrous chloride and benzylammonium ferrous chloride appear to exhibit two-dimensional magnetic structure, and the hyperfine parameters were interpreted in terms of the

two-dimensional Ising model. The nuclear hyperfine properties of $Mo_{2-x}Fe_xB$ where x = 0.2 and 0.5 were also studied by Moessbauer effect spectroscopy. An unsuccessful attempt was made to produce $Mo_{2-x}Fe_xB$ for x equal to 0.8, 1, 1.2, 1.5, and 1.8. In every case, x-ray spectroscopy revealed Mo_2FeB_2 and free iron. The effective fields of powder samples of $Mo_{1.8}Fe_{0.2}B$ and $Mo_{1.5}Fe_{0.5}B$ as a function of temperature were determined by transmission experiments. The lack of dependence of the isomer shift, transition temperature, and hyperfine field of iron in $Mo_{2-x}Fe_xB$ on iron concentration indicates that the iron in the Mo_2B matrix is well screened. Isomer shift data may be interpreted as suggesting an electron transfer from boron to the metal 3d band. (auth)

24487 (SLL-74-0028) PLASMA SPRAYING Nb/Al_2O_3 CERMETS. Rowe, K. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 16p. Dep. NTIS $4.00.

A technique is described for plasma spraying strong, dense cermets consisting of niobium and Al_2O_3. This technique may provide a means for fabricating cermets of components that react at conventional powder metallurgical temperatures. (auth)

24488 (TRG-Report-2545(S)) CHARACTERISATION OF NUCLEAR DISPERSION FUELS. The Non-Destructive Examination of Silicon Carbide by Selenium Immersion. Ambler, J. F. R.; Ferguson, I. F. (UKAEA Reactor Group, Springfields). Jul 1974. 19p. Dep. NTIS (US Sales Only) $4.00. UK 50 Pence.

The nondestructive microscopic examination of silicon carbide-coated uranium carbide spheres, which involves immersing the coated spheres in selenium, is particularly suited to the examination of flaws in the coats, but it is not possible to measure coating thicknesses by this method. Some coats are found to be opaque and this is related to their porosity. (16 fig) (auth)

24489 (UCID-15593) EVALUATION OF HIGH-STRENGTH, HIGH-MODULUS BERYLLIUM OXIDE/GLASS FIBER. Chiao, T. T.; Lewis, A.; Kimpel, R. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Dec 1969. 17p. Dep. NTIS $4.00.

A high-strength, high-modulus S-glass fiber containing beryllium oxide was evaluated for mechanical properties, with the standard commerical S-glass as the control. In a 30-day continuous run, over 500 lb of good-quality fiber was made from a production bushing having 204 holes. The fiber strength of several forms was examined including 1) virgin filaments; 2) sized filaments removed from strands; 3) single-end dry (no matrix) strands; 4) glass/epoxy single-end strands; and 5) roving-wound pressure vessels. The fiber sizing was evaluated by measuring the torsional shear in glass/epoxy rods. In comparison with the commerical S-glass, the beryllium oxide S-glass fiber was superior in modulus and filament tensile strength, but there was no significant difference in any of the other properties tested. (auth)

24490 MAGNETIC IMPURITY STATES IN $Eu_{1-x}Gd_xO$. Samokhvalov, A.A.; Arbuzova, T.I.; Simonova, M.I.; Fal'kovskaya, L.D. (Institute of Metal Physics, Academy of Sciences of the USSR, Sverdlovsk). Sov. Phys.-Solid State 15: No. 12, 2459-2460 (June 1974).

Variations of Curie temperature and reciprocal magnetic susceptibility for single crystals of $Eu_{1-x}Gd_xO$ ($0 \leq x \leq 0.05$) was investigated as a function of lattice parameter. The theory of magnetic impurity states was used to correlate observed anomalies with a magnetic impurity model. (AIP)

24491 ORDER-DISORDER TRANSFORMATION OF O ATOMS DISSOLVED IN Zr STUDIED BY NEUTRON DIFFRACTION. Hirabayashi, M.; Yamaguchi, S.; Arai, T.; Asano, H.; Hashimoto, S. (Tohoku Univ., Sendai). Phys. Status Solidi (a); 23: No. 1, 331-339 (16 May 1974).

Neutron diffraction experiments were made to reveal the nature of the interstitial order-disorder transformation in the Zr-O system using single crystals. The disordering transition of the alloy with $O/Zr \lesssim 0.3$ occurs below 450°C, while in the composition O/Zr = 0.3 to 0.4 the disordering undergoes stepwise in such a way that the stacking sequence of the oxygen-atom layers changes below 600°C and subsequently the ordered distribution in the layers becomes random. A tentative phase diagram is proposed. (10 fig) (auth)

24492 STRUCTURE OF THE COMPENSATION WALL IN FERRIMAGNETS. Krumme, J. P. (Philips Forschungslaboratorium, Hamburg). Phys. Status Solidi (a); 23: No. 1, 33-41 (16 May 1974).

There exist two limiting cases of the structure of the compensation wall (CW) in ferrimagnets: the Bloch- and the Néel-type, depending on the configuration of the preferred magnetic direction and the compensation plane (CP). Any wall structure intermediate of both is shown to exist. The CW width does not expand with increasing field, as previously believed. Inner natural growth faces in single crystal ferrimagnets can be "decorated" by CW's. Compounds studied are $Y_3Fe_{5-t}Ga_tO_{12}$ and $Y_{2.34}Gd_{0.52}Yb_{0.14}Fe_{3.74}Ga_{1.26}O_{12}$. (auth)

24493 GROWTH OF $CaWO_4-Nd^{3+}$ SINGLE CRYSTALS BY CZOCHRALSKI TECHNIQUE. Narula, R. C.; Thyagarajan, R.; Mohan, M.; Parashar, T. R. (Solid State Physics Lab., Delhi). Indian J. Pure Appl. Phys.; 12: No. 2, 92-94 (Feb 1974).

Single crystals of $CaWO_4$ doped with neodymium to an extent of 1 to 2% were grown from melt following the Czochralski technique. Studies on absorption spectra confirm the presence of Nd^{3+} ions in $CaWO_4$ lattice and compensated with Na^+ ions. These single crystals grown both along c- and a-axes are optically clear with a lilac color characteristic of Nd^{3+} in $CaWO_4$. (auth)

24494 STUDY ON WELDABILITY OF DISPERSION HARDENING ALLOYS. I. Behavior of ThO_2 Particle Under the Melting-Solidification of Dispersion Hardening Alloy TD Nickel. Ikawa, H. (Osaka Univ., Suita, Japan); Shin, S.; Habu, M. Yosetsu Gakkaishi; 43: No. 5, 441-451 (May 1974). (In Japanese).

Dispersion hardening alloys possess superior tensile properties at elevated temperature. On welding of dispersion hardening alloys, some problems regarding brittleness at the joint caused by agglomeration and decomposition of dispersed particles can be pointed out. The weldability of TD nickel, especially on behavior of dispersing particles in welded zone was studied. It was found that in case of fusion welding of TD nickel, fusion zone is micrographically separated into three different regions, that is Region I, Region II, and Region III. Even if melting-solidification time is about 1/6 s, its separation occurs. Transmission electron microscopy of solidified TD nickel revealed that the previous three regions are separated by distribution of ThO_2 particles. Namely, in Region I, ThO_2 particles make agglomeration and growth to some degree and form the honeycomb structure. In Region II, ThO_2 particles make agglomeration and growth larger than in Region I. In Region III, ThO_2 particles are excluded when matrix nickel is melted and solidified, and so it had the solidified structure of pure nickel. It is experimentally evident that ThO_2 particles are excluded out of the surface of molten nickel, in spite of the difference of density between molten nickel and ThO_2. (auth)

24495 SCANNING MICROSCOPIC OBSERVATION OF CERAMICS. Suzuki, H. (Tokyo Inst. of Tech.); Hase, T.; Kimura, S. pp 795-797 of Proceedings of the Sixth International Conference on X-Ray Optics and Microanalysis. Shinoda, G. (ed.). Tokyo; Univ. of Tokyo Press (1972).

From 6th international conference on x-ray optics and microanalysis; Osaka, Japan (5 Sep 1971).

Scanning electron microscopes are popular instruments for the observation of microstructure because of their high resolution power of 200 Å. Examples of their use on ceramics, namely graphite reacted with silicon, beryllium oxide formed by chemical vapor deposition, and beryllium oxide compacts at initial sintering stage, are given. The microscope employed is JSM-S1 with electron acceleration voltage of 10 keV at room temperature. The method is as follows. For the reaction of graphite and metallic silicon, large crystals of Kish graphite were used, with which a fresh and flat surface was prepared by pulling the graphite out parallel to base plane. On this surface, metallic silicon of 99.99% in purity was spattered up to about 300 Å in thickness in vacuum. During crystal growth of beryllium oxide by chemical vapor deposition, various microstructures were observed, depending on deposition environment, such as deposition temperature 500 to 1400°C, feeding rate of beryllium chloride 0.26 to 2.28 $g/cm^2/h$, total flow rate of H_2 and CO_2 110:1, 850 ml/min, and their mixing rate. Isothermal shrinkage of powder compacts was measured at the initial stage of sintering of highly pure active beryllium oxide. This process was characterized by a straight line with slope of unity on the plot of logarithmic shrinkage in relation to logarithmic time, and it was accompanied by a large amount of shrinkage from 46% to about 57% of TD. This process was then followed by volume diffusion process, which gave slope of 0.46 on the same plot at intermediate stage. (JA)

24496 MULTIPLE PHASES IN THE SYSTEM $MgF_2-Nb_2O_5$. An Electron Microscope Study of Intergrowths, Defects, and Disordered Crystals. Hutchison, J. L. (Oxford Univ.); Lincoln, F. J.; Anderson, J. S. J. Solid State Chem.; 10: No. 4, 312-322 (Aug 1974).

Mixtures of $MgF_2 \cdot xNb_2O_5$ with x = 7 and 14 have, on annealing at high temperatures, yielded a wide variety of block structures in which MgF_2 has replaced MeO_2 (Me = Ti^{4+}, Nb^{4+}). With F^- stabilizing the formation of large blocks, numerous defect structures have been characterized by direct lattice resolution electron microscopy. Features thus observed include planar faults, inter-

growths, segregated domain structures, and disordered crystals. Chemical implications of these features are discussed. (auth)

24497 THERMODYNAMICS AND PHASE RELATIONSHIPS OF THE TERNARY La–U–O SYSTEM. Stadlbauer, E.; Wichmann, U.; Lott, U.; Keller, C. (Kernforschungszentrum, Karlsruhe, Ger.). J. Solid State Chem.; 10: No. 4, 341-350(Aug 1974).

In the selected regions La: (La + U) = 0.05 and O: (La + U) = 2.00 of the ternary system La–U–O, emf measurements on solid state galvanic cells, coulometric titrations, and x-ray diffraction techniques were used to obtain phase boundaries and thermodynamic data in the temperature range from 600 to 1000°C. For the first time, order ⇌ disorder transformations of $La_{1-y}U_yO_{2+x}$ up to 15 mole % La are reported. The transformation temperature is 1415°K for $UO_{2.23}$; 1397°K for $La_{0.05}U_{0.95}O_{2.23}$, and 1449°K for $La_{0.15}U_{0.85}O_{2.23}$. The vibrational entropy component of excess oxygen in $M_{1-y}U_yO_{2+x}$ is estimated. (auth)

24498 LOW-TEMPERATURE THERMAL EXPANSION OF MnB_2. Bowman, A. L.; Nereson, N. G. (Los Alamos Scientific Lab., NM). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 17, 34-36 (1974).

From international symposium on thermal expansion of solids; Lake of the Ozarks, Missouri, USA (7 Nov 1973). See CONF-731118-.

The anisotropic thermal expansion of manganese diboride has been determined with neutron diffraction over the temperature range 5 to 298°K. The variation of lattice parameter with temperature is defined by the equations $a = 3.0044 + 4.9 \times 10^{-6}$ T, $c = 3.0358 - 2 \times 10^{-6}$ T $+ 7 \times 10^{-8}$ T^2. The c parameter is found to contract initially, passing through a minimum at 14°K. (auth)

24499 EPR SPECTRA OF V^{4+} IONS IN VO_2 MONOCRYSTALS. Grunin, V. S.; Ioffe, V. A.; Patrina, I. B. (Inst. of Silicate Chemistry, Leningrad). Phys. Status Solidi (b); 63: No. 2, 629-634(1 Jun 1974). (In French).

An investigation was made of the EPR spectra of VO_2 crystals at X- and Q-band at a temperature of 77°K. There is the spectrum of V^{4+} ions in all of the crystals. A spin-Hamiltonian of rhombic symmetry is applicable with the parameters: $g_x = 1.895 \pm 0.002$, $A_x = 47 \times 10^{-4}$ cm^{-1}, $g_y = 1.930 \pm 0.005$, $A_y = 44 \times 10^{-4}$ cm^{-1}, $g_z = 1.925 \pm 0.001$, and $A_z = 147 \times 10^{-4}$ cm^{-1}. The ground state wave function is $d_{x^2-y^2}$. Comparison of the results with those of isolated V^{4+} in rutile type structure shows that the unpaired 3d-electrons are not affected by the host structure of VO_2. The probable reason of the electron appearance in the vanadium sublattice are M^{4+} impurity ions without 3d electrons. (auth)

24500 DYNAMIC THEORY OF FORBIDDEN SPOTS APPEARING ON THE ELECTRON DIFFRACTION DIAGRAMS. Study of the Case of Thin Layers of Type C Rare Earth Sesquioxides. Pardo, B.; Zogheib, H. (Paris Univ., Orsay, France). Phys. Status Solidi (a); 24: No. 1, 91-97(16 Jul 1974). (In French).

Electron diffraction patterns of C-type rare earth sesquioxides thin films exhibit forbidden spots within the admitted T_h^7 space group. The existence of these forbidden spots is explained within the framework of the dynamical N-wave theory making use of the diffusion matrix. Numerical computations are compared to the experimental data for dysprosium sesquioxide (C-Dy_2O_3). (auth)

24501 CROSS RELAXATION $^5D_3(\Gamma_3,\Gamma_4) \rightarrow {}^7F_6(2\Gamma_2)$ OF THE Tb^{3+} ION IN $CaWO_4$: OPTICAL DETECTION. Fournier, D.; Boccara, A. C. (Superieure de Physique et de Chimie Industrielles, Paris). Phys. Status Solidi (b); 64: No. 1, 87-93(1 Jul 1974). (In French).

The $^7F_6(2\Gamma_2)$ ground state resonance of the Tb^{3+} ion in $CaWO_4$ is detected by magnetically induced polarization of the $^5D_3(\Gamma_3, \Gamma_4) \rightarrow {}^7F_j(\Gamma_1$ or $\Gamma_2)$ fluorescence lines. This process, which occurs between two levels whose g values are quite different, could be explained if a cross relaxation followed by a spin diffusion through the ground state hyperfine components is involved. (auth)

24502 POSITRON ANNIHILATION IN SOME ANTIFERROMAGNETIC MATERIALS. Kulkarni, V. G. (Tata Inst. of Fundamental Research, Bombay); Dave, N. K. Phys. Status Solidi (b); 64: No. 1, K75-K78(1 Jul 1974).

Positron lifetimes and intensities were measured in CoO, Cr_2O_3, MnTe, and V_2O_3 around the Neel temperature, T_N. For CoO and Cr_2O_3, the long-lived intensity decreased below T_N, while the lifetimes did not vary. For MnTe, no significant variation in any parameter was observed. V_2O_3 showed a more complex behavior of both intensity and lifetime. (DLC)

24503 MAGNETIC TRANSFORMATION AND p–n TRANSITION IN Ni–Zn FERRITE INDUCED BY A NEUTRON FIELD. Tchukalkin, Yu. G.; Vologin, V. G.; Goshchitskii, B. N.; Dubinin, S. F.; Petrov, V. V.; Parkhomenko, V. D.; Sidorov, S. K. (Inst. of Metal Physics, Sverdlovsk, USSR). Phys. Status Solidi (a); 23: No. 2, K159-K161(16 Jun 1974).

The temperature behavior (from 4.2 to 600°K) of the spontaneous magnetization, the intensity of small-angle diffuse magnetic (SDM) neutron scattering, and the values of electroresistance and types of conductivity of the $Zn_{0.68}Ni_{0.32}Fe_2O_4$ ferrite as functions of irradiation dose of fast neutrons ($E_n \geq 0.8$ MeV) were studied. It was found that as a result of irradiation, the electroresistance decreases by three orders approximately and the type of conductivity is altered, i.e. a p–n transition induced by the neutron field takes place. The observed effect may be explained by partial oxygen dissociation, leading to an increase of donor concentration and, as a result, to a change of the compensation rate. The magnetic transformation and the p–n transition in the ferrite, induced by a fast neutron field are caused by the appearance of disordered microregions, appearing at irradiation under the influence of the so-called "displacement spikes". High temperatures and extremely fast quenching in regions occupied by displacement spikes, contribute to the random distribution of cations over sublattices and may lead to partial oxygen dissociation. (auth)

24504 STRUCTURE OF CUBIC C TYPE RARE EARTH SESQUIOXIDES. Diagrams of Electron Diffraction and Group Space. Boulesteix, C. (Paris Univ., Orsay, France); Caro, P. E.; Gasgnier, M.; la Blanchetais, C. H.; Pardo, B.; Schiffmacher, G. Phys. Status Solidi (a); 23: No. 2, 597-604. (In French).

The C-type of rare earth sesquioxides is studied by electron microscopy and diffraction. The patterns are characterized by supplementary diffraction rings and spots (110, 330,...) with respect to x-ray diffraction, which seem to be incompatible with the admitted T_h^7 space group of C-Ln_2O_3 (Ln = rare earth). The possible vacancy arrays in the fluorite structure LnO_2 yielding the Ln_2O_3 stoichiometry are discussed. It is shown, however, that the additional forbidden spots do not belong to the reciprocal lattice. (auth)

24505 MORTARS FOR ZIRCONIA REFRACTORIES. Karaulov, A. G.; Grebenyuk, A. A. (Scientific Inst. for Refractories, Kiev). Refractories (USSR) (Engl. Transl.); 14: No. 7-8, 513-518(1973).

Translated from Ogneupory; 14: No. 8, 52-59(Aug 1973).

The feasibility of using ZrO_2 cement and orthophosphoric acid in production of a mortar for ZrO_2 refractories was studied. It was found that the filler should be stabilized ZrO_2 powder of a particle size below 0.5 mm with 10% monoclinic fine-grain ZrO_2 mixed with orthophosphoric acid added in the proportion of 2 to 4% in terms of P_2O_5. A mortar with zirconia refractory linings was tested and gave satisfactory results. Owing to its low water retention capacity and short setting time $Ca_7Al_6ZrO_{18}$ cement cannot be recommended for a zirconia base mortar. (JRD)

24506 EFFECT OF DISPERSION OF PURE YTTRIUM OXIDE ON ITS PRESSING AND SINTERING. Kozlova, A. E.; Lukin, E. S.; Poluboyarinov, D. N. (Inst. of Chemical Technology, Moscow). Refractories (USSR) (Engl. Transl.); 14: No. 7-8, 417-421(1973).

Translated from Ogneupory; 14: No. 7, 22-26(Jul 1973).

Y_2O_3 powders were prepared by wet grinding using balls made of Y_2O_3. Studies of these powders showed that they are initially aggregated; the aggregates consist of particles of different size. In order to break down the aggregation of crystals in the original Y_2O_3 it is sufficient to use short-term grinding (6h) with the wet method in a ball mill; this yields a powder with a high dispersion and excellent pressibility. Grinding yttrium oxide in a drum made of plastic with balls made of Y_2O_3 excludes material contamination, the balls are scarcely worn away during operation, and the grinding pick-up from the lining of the mill is slight. Specimens of yttrium oxide heat processed at 900°C and ground for 6h have the maximum density; grinding the Y_2O_3 reduces the specific fabrication pressure. After firing at 1650°C the maximum density is recorded in specimens of Y_2O_3 ground for 6 h. The specimens made from the original Y_2O_3 of the same density were obtained only after firing at 1850°C in vacuum. (auth)

24507 CHARACTERIZATION OF PARAMAGNETIC HOLE-CENTERS IN Al_2O_3 AND Al_2O_3 : Fe BY OPTICAL AND EPR ABSORPTION. Bauer, C. F.; Whitmore, D. H. (Northwestern Univ., Evanston, IL). J. Solid State Chem.; 11: No. 1, 38-52(Sep 1974).

The electron paramagnetic resonance (EPR) and optical absorption spectra of nominally pure and Fe-doped single crystals of Al_2O_3 were examined before and after gamma-ray irradiation at 77°K. The EPR spectra for doped and irradiated crystals were found to be a function of the iron concentration. Analysis of the optical and EPR spectra observed on the same Fe-doped crystals which had been subjected to gamma-ray irradiations suggests that

the center which accounts most satisfactorily for the details of these spectra is a single trapped-hole localized on an anion which is adjacent to a substitutional divalent iron impurity atom. The optical absorption band ascribed to this center occurs at 3.08 eV. (11 figures, 4 tables) (auth)

24508 USE OF STABILIZED ZrO_2 TO MEASURE O_2 PERMEATION. Kitazawa, K.; Coble, R. L. (Massachusetts Inst. of Tech., Cambridge). J. Amer. Ceram. Soc.; 57: No. 8, 360-363(Aug 1974).

The rate of permeation of CaO-stabilized ZrO_2 (CSZ) by O_2 gas was measured from 640 to 1200°C with the CSZ tubing used simultaneously as the sample and the O_2 pressure detector. The apparent permeation rate depended significantly on the O_2 pressure at the low-pressure side. The measured rate was orders of magnitude smaller than that measured under steady-state conditions, except when the O_2 partial pressure was high ($>10^{-4}$ atm), in which case the agreement was good. The difference between steady-state permeability and non-steady-state permeability is related to the deviation in stoichiometry in a sample or detector. The transient response (measured under variable pressure difference) may be very different from steady-state permeation (measured under constant differential pressures across the membranes). To apply CSZ to typical O_2 gas permeability measurements, the O_2 pressure must be kept above $\approx 10^{-3.5}$ atm. In this range, the permeability of CSZ may be regarded as a temperature-dependent material property which is governed by the electron-hole mobility. At lower O_2 pressures the permeation rate is a more complex function of the pressure difference and level. (9 figures) (auth)

24509 INFLUENCE OF DEVIATIONS FROM STOICHIOMETRIC COMPOSITION ON THE ELECTRICAL, OPTICAL, AND ELECTROOPTIC PROPERTIES OF V_2O_3 SINGLE CRYSTALS. Mokerov, V.G.; Galiev, G.B. Sov. Phys.-Solid State 16: No. 1, 175-176 (July 1974).

Changes in electrorelectance spectra and differential capacitance in stoichiometric and non-stoichiometric V_2O_3 single crystals have been observed. It is postulated that such changes are due to variation in band structure caused by stoichiometric defects. (AIP) (auth)

24510 MAGNETIC SPECIFIC HEAT OF LANTHANUM ORTHOVANADITE. Borukhovich, A.S.; Bazuev, G.V. (Institute of Chemistry, Ural Scientific Center, Academy of Sciences of the USSR, Sverdlovsk). Sov. Phys.-Solid State 16: No. 1, 181-182 (July 1974).

The temperature dependence of the specific heat of $LaVO_3$ has been measured in the $0.38 \leq T/T_n \leq 2.2$ range. The magnetic and lattice components of the specific heat are calculated from the data and exchange parameters are estimated for the spin-ordered state of $LaVO_3$. (AIP)

24511 STRUCTURE/PROPERTY/PROCESS RELATIONSHIPS IN CHEMICAL VAPOR DEPOSITION CVD. Blocher, J.M. Jr. (Battelle-Columbus, Columbus, Ohio 43201). J. Vac. Sci. Technol. 11: No. 4, 680-686 (July 1974).

Although chemical vapor deposition is capable of yielding a wide variety of materials in structures ranging from amorphous, to fine-grained, needle-like, single crystals, and epitaxial films, the structure/property/process relationships have received greatest attention for a limited number of materials whose economic and technological importance are most significant. The effects of temperature and effective supersaturation on the structure/property/process relationships are reviewed for semiconductor silicon, pyrolytic carbon, and CVD tungsten, for which extensive data are available. Suggestions are made for research in areas that would improve understanding of CVD and increase its range of applicability. (auth)

24512 APPLICATION OF THICK FILM AND BULK COATING TECHNOLOGY TO THE SUBTERRENE PROGRAM. Stark, W.A. Jr.; Wallace, T.C.; Witteman, W.; Krupka, M.C.; David, W.R.; Radosevich, C. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). J. Vac. Sci. Technol. 11: No. 4, 802-805 (July 1974).

The Subterrene is a rock-melting earth-penetration system representing a significant advancement in excavation technology. Temperatures of 1700-2000 K are involved, and heated refractory metal or alloy probes are used. Corrosion problems are severe on the exterior surfaces of the refractory metals used; bulk coatings having the required properties would be extremely desirable, provided they could be deposited upon a substrate as a tenacious coating. Within the Subterrene, pyrographite radiant heaters are operating at temperatures to 2450 K. Graphite receptors added to improve the radiant heat transfer react with the molybdenum and tungsten penetrator bodies to form the respective carbides. A 30-μ thick CVD film of TaC may be applied to inhibit this reaction. The techniques of applying these films, their nature, and the results of their application, are discussed. The environment of an operating penetrator is described, and the requirements and properties of exterior coating are outlined. (auth)

24513 ELECTRONIC BAND STRUCTURES AND CHARGE DENSITIES OF NbC AND NbN. Chadi, D.J.; Cohen, M.L. (Department of Physics, University of California, Berkeley, California 94720 and Inorganic Materials Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). Phys. Rev. B 10: No. 2, 496-500 (15 July 1974).

We present nonlocal-pseudopotential calculations of the electronic band structures and charge densities of NbC and NbN. The major contribution to the charge density of the bands near the Fermi energy comes from C or N 2p states. The charge density for the first partially filled Nb 4d band and the shape of the Fermi surface for this band are also discussed. (auth)

24514 X-RAY DIFFRACTION STUDY OF METALLIC VO_2. McWhan, D.B. (Bell Laboratories, Murray Hill, New Jersey 07974); Marezio, M.; Remeika, J.P.; Dernier, P.D. Phys. Rev. B 10: No. 2, 490-495 (15 July 1974).

Refinement of the crystal structure of VO_2 at 360 and 470 K in the metallic rutile phase shows that both the vanadium and oxygen thermal displacements are larger than those found in rutile phases of TiO_2 and CrO_2 or monoclinic phases of VO_2 or $V_{0.976}Cr_{0.024}O_2$. The vanadium-vanadium distance along the rutile c axis is anomalously short when compared with neighboring rutile phases while the other nearest-neighbor metal-metal and metal-oxygen distances vary smoothly across the series. A comparison of Debye temperatures calculated from heat-capacity and x-ray data suggests the presence of low-lying vibrational modes in metallic VO_2. (auth)

24515 PREPARATION AND STRUCTURE OF CRYSTALS OF POTASSIUM EUROPIUM MOLYBDATE, $KEu(MoO_4)_2$. Klevtsova, R.F.; Kozeeva, L.P.; Klevtsov, P.V. (Institute of Inorganic Chemistry, Siberian Branch, Academy of Sciences of the USSR). Sov. Phys.-Crystallogr. 19: No. 1, 50-53 (July 1974).

Single crystals of $KEu(MoO_4)_2$ have been obtained by spontaneous crystallization by slowly cooling a solution in fused potassium bimolybdate. They are triclinic. Their unit-cell parameters are a = 11.20, b=5.30, c=12.81 Å, α=90, β=114, γ=90°; Z=4, d_x=4.90 g/cm³, f. gr. P1. In the structure, two independent Mo atoms have tetrahedral coordination (the mean Mo—O distances are 1.78 and 1.79 Å), and the K and Eu atoms lie within eight-vertex figures. The polyhedra are linked into a three-dimensional structure via common edges of the K and Eu eight-vertex figures and vertices of the Mo tetrahedra. On heating, the triclinic modification (α) undergoes a transition to a monoclinic modification (β). The structures of both modifications are related to that of scheelite. A crystallochemical analysis is given of the relation between the structure of α-$KEu(MoO_4)_2$ and scheelite $CaWO_4$. The compound melts congruently at 1000°C. (auth)

24516 PHASE TRANSFORMATIONS IN SOME RARE EARTH-HYDROGEN SYSTEMS. Mintz, M. H. (Israel Atomic Energy Commission, Beersheba); Hadari, Z.; Bixon, M. J. Less-Common Metals; 37: No. 3, 331-335(Sep 1974).

The ranges of stability of Pr, Nd, and Sm hydrides were investigated using simultaneous thermogravimetric-differential thermal analysis techniques. Measurements were made over a temperature range 25 to 700°C, at 700 torr hydrogen pressure. A new, low-temperature hexagonal phase has been detected in the NdH_2-NdH_3 system. Its structure is similar to the hexagonal, heavier lanthanide hydride phases. However, unlike these structures the NdH_{3-x} hexagonal phase transforms irreversibly on heating to the fcc structure, which remains metastable at room temperature. The enthalpy changes associated with the hexagonal to fcc transitions in the NdH_2-NdH_3 and SmH_2-SmH_3 systems were estimated to be 1.6 ± 0.3 kcal/mole and 4 ± 0.4 kcal/mole, respectively. No phase transition has been detected in the PrH_2-PrH_3 system. (auth)

24517 PHASE RELATIONS AND DIELECTRIC BEHAVIOR OF $(Pb,La)Zr_{0.55}Ti_{0.45}O_3$ CERAMICS WITH A DIFFUSE PHASE TRANSITION REGION. Wolters, M.; Burggraaf, A. J. (Twente Univ. of Tech., Enschede, Netherlands). Phys. Status Solidi (a); 24: No. 1, K11-K13(16 Jul 1974).

Phase relations in $(Pb,La)Zr_{0.55}Ti_{0.45}O_3$ ceramics were investigated by means of x-ray diffraction and dielectric measurements as functions of the La concentration and temperature. Between a tetragonal, ferroelectric phase (FE) and a cubic, paraelectric phase (PE), in the phase diagram a pseudo-cubic phase, a so-called quasi-ferroelectric phase (QFE) was found. The phase boundary FE-QFE found from dielectric and x-ray data approximately coincides, while the unit cell volume and unit cell dimensions show discontinuities at this boundary. The dielectric properties were investigated in the QFE and PE phase fields as functions of temperature and frequency. The dielectric constant e as a function of temperature could be represented in both the phase fields by a quadratic law of the type $e^{-1} = e^{-1}_{max} + C(T - T'_c)^2$, while T'_c as well as tan δ_{max} were dependent on the frequency. (7 fig, 4 tables) (auth)

24518 ELECTRIC AND MAGNETIC PROPERTIES OF $(Bi_{1-x}La_x)FeO_3$ SOLID SOLUTIONS. Polomska, M.; Kaczmarek,

W.; Pajak, Z. (Inst. of Physics, Poznan, Poland). Phys. Status Solidi (a); 23: No. 2, 567-574(16 Jun 1974).

Results are reported on the electric and magnetic properties of $(Bi_{1-x}La_x)FeO_3$ solid solution exhibiting simultaneously long-range order of electric and magnetic dipoles. In the concentration range $0 \leqq x < 0.30$ close to the Néel temperature, an anomaly of $\epsilon(T)$ attributed to the influence of a decay of magnetic ordering on the electric ordering, was observed. A temperature-concentration phase diagram is constructed. Within the framework of Benguigui's theory [Solid State Commun. 11,825(1972)], an explanation is proposed for the anomaly in electric properties at the transition boundaries between structural modifications. (auth)

24519 EFFECTS OF HIGH NONSTOICHIOMETRY ON EuO PROPERTIES. Massenet, O.; Capiomont, Y.; Dang, N.V. (Groupe des Transitions de Phases, CNRS, Avenue des Martyrs, 38 Grenoble, France). J. Appl. Phys. 45: No. 8, 3593-3599 (Aug 1974).

Electric, magnetic, and electron paramagnetic resonance (EPR) measurements have been performed on thin EuO films prepared either by reactive evaporation of Eu at 400 °C or by oxidation of a Eu metal thin film at 200-250 °C. The films obtained by reactive evaporation have electrical and magnetic properties very similar to those reported for EuO single crystals of various degrees of nonstoichiometry. The films prepared by oxidation of Eu films at 200-250 °C are characterized by a much higher-valued Curie temperature ($T_c \simeq 148$ K), while their resistivity is in the range 10^{-2}-1 Ω cm. The EPR signal can be attributed to Eu spins, which shows that in these films there exist fluctuations of Eu doping due to nonstoichiometry. We analyzed the high concentration of oxygen vacancies in the bound magnetic polaron (BMP) model. A high level of defects and oxygen vacancies, inhomogeneously distributed in the film, can account for both their electrical and magnetic properties. (auth)

24520 DEFECT CENTERS IN A GERMANIUM-DOPED SILICA-CORE OPTICAL FIBER. Friebele, E.J.; Griscom, D.L.; Sigel, G.H. Jr. (Naval Research Laboratory, Washington, D.C. 20375). J. Appl. Phys. 45: No. 8, 3424-3428 (Aug 1974).

The radiation-induced defect centers in a low-loss Corning germanium-doped optical fiber have been studied. In addition to silicon E' centers, four germanium-related centers, corresponding to electrons trapped at the site of oxygen vacancies in sp^3 orbitals of germanium ions with zero to three next-nearest-neighbor germaniums, were observed. A model which assumes Gaussian distributions in the excited-state energy-level splittings has been successfully used to computer simulate the ESR spectrum of the irradiated fiber. (auth)

24521 METHOD AND INSTALLATION FOR THE EXPERIMENTAL DETERMINATION OF THE TRANSITION FROM THE GASEOUS TO THE CONDENSED DISSOCIATION OF COMPOUNDS. Balankin, S. A.; Skorov, D. M.; Sokolov, V. S. pp 164-167 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

An experimental method was proposed for the determination of the transition temperatures of compounds from gaseous dissociation to condensed dissociation according to the temperature dependence of the evaporation rate. Studies of the evaporation rate of zirconium nitride were made on a specially constructed installation. From the experimental data the transition temperature of ZrN from one form of dissociation to the other was found. It agrees well with calculated data reported in the literature. (tr-auth)

24522 STABILITY AND DUCTILITY OF ZIRCONIUM CARBIDE IN THE REGION OF HOMOGENEITY. Ivanov, O. S.; Gomozov, L. I.; Dedyurin, A. I.; Kotel'nikov, R. B.; Zotov, Yu. P.; Belevantsev, V. A. pp 168-178 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The mechanical properties of ZrC in all region of homogeneity were studied at temperatures from 20 to 3000°C on sintered or fused samples subjected to high-temperature annealing. The yield point obeyed the Hall-Petch relation in which the increased values of the coefficient K (1.58 in comparison with 0.2 for metals) showed the difficulty of transmitting deformation from grain to grain. Hardening because of secondary segregation of graphite for the composition $ZrC_{0.99}$ and abnormal increase of the yield point for $ZrC_{0.9}$ at 2500 to 2600°C were observed. At temperatures above 0.65 to 0.7 T_m intergrain separation introduced a significant contribution to deformation. A notch in the yield diagram was detected for samples slowly cooled from high temperatures. From its strength and ductile properties and the very high resistance of the grain to growth at high temperatures the composition $ZrC_{0.9}$ shows promise as a heat-resistant material. (tr-auth)

24523 SOME REGULARITIES IN THE CHANGES OF THE STRENGTH OF CARBIDE MATERIALS. Gomozov, L. I.; Dedyurin, A. I.; Ivanov, O. S. pp 178-192 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The strength and ductility characteristics and the dislocation structure of a series of carbides and their solid solutions were studied at temperatures up to 3000°C. Carbides of Zr, U, Ta, and Nb and UC-ZrC and ZrC-TaC solid solutions were studied. A reduction of the microhardness of carbides of metals of the IVA group was observed in the region of composition close to stoichiometry. At temperatures above 100 to 200°C the yield point, evaluated by the microhardness, increased for ZrC_x to the stoichiometric composition which leads to a corresponding decrease of the brittle to ductile transition temperature. Four temperature regions, corresponding to different mechanisms controlled by the plastic deformation of the carbide, were found. The creation of static (dimensional) deformation in metallic sublattices because of alloying appears the basic method for achieving high heat resistance of the carbide materials. The effect of high temperature annealing on the structure, equilibrium, and non-equilibrium segregations and properties of the carbide materials was examined. It is shown that the formation of solid solutions of carbides increases the temperature of the brittle-to-ductile transition temperature and improves (in the region of 5 to 20 mole % additions) the resistance of the intergrain dissociation in the high temperature region. (tr-auth)

24524 CROSS SECTIONS OF THE TERNARY SYSTEM Al_2O_3-Y_2O_3-WO_3. Kislyakov, I. P.; Kopeikin, S. I.; Firsanova, V. V. (Moscow Inst. of Fine Chemical Technology). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 7, 955-958(1974). (In Russian).

Interaction in the following cross sections of the ternary system $Al_2O_3-Y_2O_3-WO_3$ was studied by differential thermal analysis, microvisual semithermal methods, x-ray phase analysis, and microstructural analysis: $Al_2(WO_4)_3-Y_2O_3$, $Al_2(WO_4)_3-Y_2(WO_4)_3$, $Al_2O_3-Y_2(WO_4)_3$, and $3Y_2O_3 \cdot 5Al_2O_3-Y_2(WO_4)_3$. It was established that the $Al_2(WO_4)_3-Y_2(WO_4)_3$ and $Al_2O_3-Y_2(WO_4)_3$ cross sections have a eutectic character. The $Al_2(WO_4)_3-Y_2O_3$ system appears ternary and mutual. In the $Y_2(WO_4)_3-3Y_2O_3 \cdot 5Al_2O_3$ system a new phase ρ was detected at 60 mol.% $Y_2(WO_4)_3$. (tr-auth)

24525 BLENDING OF UO_2-ThO_2 POWDERS. Pope, J. M.; Radford, K. C. (Westinghouse Research Labs., Pittsburgh). Amer. Ceram. Soc. Bull.; 53: No. 8, 574-578(Aug 1974).

Both oxalate-derived ThO_2 and mixed $(U,Th)O_2$ oxides calcined at 750°C blend satisfactorily with UO_2 after ≈15-30 min. Longer times do not appreciably improve the blends. ThO_2 derived from the nitrate blends poorly by comparison. The optimum blend is achieved by calcining at 450°C for 2 h, tempering for 1 h at 850°C, and milling for 30 min. It is considered that the poor blending of this material is due mainly to its broad particle size distribution which promotes agglomeration of particles. It is tentatively suggested that the optimum blends are obtained using powders having very narrow size distributions. (4 tables, 8 figures) (auth)

24526 METALLOGRAPHY OF THE NIOBIUM-HYDROGEN SYSTEM. Schober, T.; Linke, U.; Wenzl, H. (Institut fuer Festkoerperforschung, Juelich, Ger.). Scr. Met.; 8: No. 7, 805-812 (Jul 1974).

Results of an electron microscopic study of NbH are presented. It was found that at low concentrations β-phase precipitation occurred in the form of thin plates on {100}. As the concentration increased, thicker plates were observed which extended throughout the whole sample. This type of behavior is illustrated. At higher concentrations (c ≲ 65 to 70%), the whole specimen was in the β-phase except for lenticular plates of the α-phase on $\{100\}_{bcc}$. Precipitation as observed on {100} planes is illustrated schematically for 3 concentrations. The results apply only to equilibrium conditions where the samples were charged at temperatures above the critical point temperature and were cooled down at a sufficiently slow rate. Under non-equilibrium conditions (for example fast electrolytic charging at room temperature or very fast cooling from higher temperatures) a variety of hydride morphologies was observed including dendritic, round, square and star shaped particles. Examples for such hydrides are presented. (JRP)

24527 HIGH TEMPERATURE LATTICE PARAMETER, MACROSCOPIC LENGTH, AND MACROSCOPIC VOLUME STUDY OF THE DEFECT STRUCTURE OF NONSTOICHIOMETRIC CERIUM DIOXIDE. Sims, J. R. Milwaukee; Marquette Univ. (1973). 253p. University Microfilms Order No. 74-18,238.

Thesis (Ph. D.).

High temperature x-ray lattice parameter, macroscopic length, and macroscopic volume measurements were performed on nonstoichiometric CeO_2 in the temperature range of 800 to 1000°C and from oxygen partial pressures of 10^{-12} to 10^{-21} atm. High temperature x-ray lattice parameter measurements were made

on powder specimens using a diffractometer. The x-ray diffraction pattern of nonstoichiometric CeO_2 was observed to remain intact, without the appearance of new diffraction profiles. The isothermal percent expansion determined from the x-ray lattice parameter measurements was observed to increase as a function of nonstoichiometric composition. The increase in the percent expansion at 1000°C was greater in the region from $CeO_{1.87}$ to $CeO_{1.77}$ in comparison with the region from $CeO_{2.00}$ to $CeO_{1.90}$. High temperature macroscopic length measurements were performed utilizing a differential dilatometer. Measurements were made on a polycrystalline sintered specimen and a single crystal specimen of CeO_2 over a similar range of nonstoichiometric compositions as the x-ray measurements. The macroscopic length measurements on the polycrystalline sintered specimen at 900 and 1000°C are in good agreement with the single crystal specimen measurements at 1000°C as a function of nonstoichiometric composition. The isothermal percent expansion determined from the macroscopic length measurements was observed to increase as a function of nonstoichiometric composition. The increase in the percent expansion was slightly greater in the region from $CeO_{2.00}$ to $CeO_{1.90}$ in comparison with the region from $CeO_{1.87}$ to $CeO_{1.77}$. High temperature macroscopic volume measurements were performed on nonstoichiometric CeO_2 at constant temperature utilizing a high temperature gas pycnometric technique. Measurements were made on polycrystalline sintered specimens and single crystal specimens to check the validity of the macroscopic length measurements. The isothermal percent expansion determined from the macroscopic volume measurements was observed to increase as a function of nonstoichiometric composition. Although a larger error is associated with these measurements in comparison with the macroscopic length measurements, they support the validity of the macroscopic length measurements. The difference, ΔD, between the percent expansion of nonstoichiometric CeO_2 at 1000°C obtained from the macroscopic length measurements and the x-ray lattice parameter measurements, was observed to be positive and have a maximum value at approximately $CeO_{1.92}$ to $CeO_{1.87}$. Based on a simple theoretical analysis, these results do not support a defect model of cerium interstitials for which ΔD should be negative. The difference ΔD should be zero for a defect model based on oxygen vacancies. A possible explanation for the positive value of ΔD could be the formation of additional unit cells as a function of nonstoichiometric composition. This could occur by the formation of Schottky defects on the anion and cation sublattice as a function of nonstoichiometric composition in addition to the nonstoichiometric defects. The maximum value of ΔD at $CeO_{1.92}$ to $CeO_{1.87}$ would then represent an increase of ~1.63% in the concentration of Schottky defects in addition to the nonstoichiometric defect concentration at this composition. These additional defects are probably not isolated but most likely form some complex with the nonstoichiometric defects. Another possible explanation of the experimental results could be defect-defect interactions or complexes which would not allow a simple explanation based on current diffraction theory and the relationships proposed for the difference between the macroscopic length and x-ray lattice parameter measurements. (Diss. Abstr. Int., B)

24528 X-RAY AND NEUTRON DIFFRACTION STUDIES OF THE DEFECT STRUCTURE IN NONSTOICHIOMETRIC CERIUM DIOXIDE. Faber, J. Jr. Milwaukee; Marquette Univ. (1973). 215p. University Microfilms Order No. 74-18,226.

Thesis (Ph. D.).

Polycrystalline samples of CeO_{2-x} ($0 < x \leq 0.21$) have been examined in the temperature range from 800 to 1000°C using x-ray and neutron diffraction techniques. The atomic defect structure of nonstoichiometric ceria was studied in this temperature range by adjusting the oxygen partial pressure between 1 and 10^{-21} atmospheres. Over this range of temperature and oxygen partial pressure, it has been observed that the lattice expands as a function of increasing defect concentration and only fluorite-like diffraction peaks have been observed. For the x-ray experiments, the integrated intensities of the Bragg reflections were analyzed for $CeO_{1.91}$, at 900°C, using difference electron density techniques. It was observed that the cation sublattice is essentially intact and evidence was found that oxygen vacancies are the predominant atomic defects in nonstoichiometric ceria. X-ray least-squares analysis on CeO_{2-x}, ($0 < x \leq 0.21$) from 800 to 1000°C supported these results and also showed that the temperature factors of both cations and anions increase with increasing defect concentration, implying greater mean-squared displacement of the atoms from their equilibrium positions. The neutron experiments were carried out at 900°C for CeO_{2-x}, ($0 \leq x \leq 0.21$), where the Bragg reflections were analyzed in terms of various defect models. For $x \leq 0.11$, good agreement (residual ≤ 1.0%) was obtained by assuming a random distribution of defects among available anion sites, in the statistically representative unit cell. The vacancy concentrations determined from the neutron data are consistent with the thermogravimetric determinations. For $0 \leq x \leq 0.11$, the temperature factors of both the metal and oxygen atoms increase with increasing vacancy concentration, implying greater root-mean-square displacement of the atoms from their equilibrium positions. However, for $x > 0.11$ the analysis of the neutron data indicates a smaller oxygen vibrational amplitude than in the near-stoichiometric compositions, but this is accompanied by a shift in the equilibrium position of the oxygen atom. The effect of anharmonic thermal motion has also been considered, but by itself, cannot explain the neutron data. The results correlate well with the x-ray studies and may be related qualitatively to thermodynamic behavior of the substoichiometric CeO_{2-x} system. (Diss. Abstr. Int., B)

24529 EFFECT OF THERMAL FATIGUE ON A TANTALUM CARBIDE REINFORCED DIRECTIONALLY SOLIDIFIED EUTECTIC COMPOSITE. Dunlevey, F. M. Jr. Cleveland; Case Western Reserve Univ. (1974). 80p. University Microfilms Order No. 74-16,483.

Thesis (Ph. D.).

A Co, Cr, Ni matrix, TaC reinforced, directionally solidified eutectic composite was cast in a Bridgeman type furnace as 1.25 cm rounds. These composites were subjected to thermal fatigue at 427 to 1093°C for up to 5000 cycles of two minute duration, and tested in stress rupture between 704 and 1204°C. The stress rupture properties of the alloy were decreased by thermal cycling. This loss in stress rupture properties varied with the number of cycles; the loss in properties after about 200 cycles was relatively high. The stress rupture strength improved with further cycling up to 2000 cycles and decreased for a larger number of cycles. The TaC fibers in the cycled material developed surface serrations which increased in severity with maximum cycling temperature and number of cycles. The formation of these serrations is attributed to the increasing solubility, from 0.4% at room temperature to 2.2% at 1200°C, of the TaC fibers in the matrix. Since the easy growth planes of the TaC fibers were not coincident with the fiber faces exposed to the matrix, the TaC which was dissolved and reprecipitated during thermal cycling formed these serrations on the easy growth planes of the fibers. These serrations act as notches which both reduce the tensile strength of the fibers and strain harden the matrix through the introduction of a dislocation network at the jagged fiber ribs. These two opposing effects produce an initial decrease in the stress rupture properties after a few thermal cycles, followed by an improvement in properties after an intermediate number with eventual marked loss in strength after a large number of thermal fatigue cycles. The formation of serrations and resultant degradation in structure and properties was unaffected by interfiber spacing, rate of temperature change on cycling, and alloy chemistry. Isothermal heat treatments up to 0.88 T_m produced no change in the phase morphology, structure, or composition. (Diss. Abstr. Int., B)

24530 CRYSTALLIZATION OF THE OXIDES OF TITANIUM SUBGROUP METALS. Kuznetsov, V. A. (ed.) (43-55). pp 43-55 of Crystallization Processes Under Hydrothermal Conditions. Lobachev, A. N. New York; Plenum Press Corp. (1973).

Results of investigations on crystallization of HfO_2, ZrO_2, and TiO_2 are presented. Information is included on crystal production in fluoride melts, and transport mechanisms of Ti, Zr, and Hf. (JRD)

Metals and Alloys

Refer also to abstracts 23610, 23748, 25839, and 25894.

Corrosion and Erosion

Refer also to abstracts 23706, 24512, and 25885.

24531 (AD-773197/9GA) KINETICS AND MECHANISM IN THE OXIDATION OF THORIUM AND URANIUM. Final Technical Report, January–June 1973. Zavitsanos, P. (General Electric Co., Philadelphia, Pa. (USA)). Oct 1973. Contract F30602-72-C-0412. 53p. (RADC-TR-73-376). NTIS $5.50.

The results of laboratory investigations which involve (1) the vaporization of thorium metal using rf heating, laser radiation heating by chemical reactions, and (2) the oxidation of thorium and uranium, are presented. It has been determined that the heat of vaporization for monoatomic thorium vapor is 143 kcal/mole. The ionization potentials of thorium (gas) and thorium oxide (gas) are quite low (5.5 to 6.0 eV), while that of thorium dioxide (ThO_2) is higher by 3 eV. The rate constant for the production of thorium dioxide ion (ThO_2^+) was determined. The results of the laser blow-off study indicate that the spectrum from uranium metal produces both neutral and singly ionized uranium atoms. (GRA)

24532 (EURFNR-1139) STUDIES ON THE REACTION BEHAVIOR OF AUSTENITIC STEELS WITH SIMULATED FISSION PRODUCTS IN THE PRESENCE OF UC. Hofmann, P. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Oct 1973. Translation of KFK-1832. 65p. Dep. NTIS $6.25.

Work performed under United States–Euratom Fast Reactor Exchange Program.

One of the problems in the operation of a fast breeder reactor is the cladding attack by the fuel when using oxide pins. Fission products are involved in all the chemical reactions between fuel and cladding that give rise to serious considerations. It is shown that the situation is somewhat different when carbide pins are used. Fission product elements were mixed with stoichiometric and overstoichiometric UC both as single elements and in groups in amounts corresponding to 10 and 20 at. % burnup. These mixtures were annealed in contact with various cladding materials. It was found that no specific fission product reactions with the cladding are to be expected in a carbide pin. Among those fission product elements which have proven themselves as very reactive with the cladding material when mixed with oxide fuel (Cs, I, Te, Se), only I reacts with the cladding material in the presence of carbide fuel. However, since I is bonded to Cs during reactor operation, it is not able to take part in the cladding attack because CsI does not react with a steel cladding in the presence of carbide fuel. An increase in carbon potential of the carbide fuel during irradiation is not to be expected. The presence of fission products seems to reduce the carburization of the cladding. (50 fig) (auth)

24533 (K-L-6339) STRIPPING METAL OXIDE AND FLUORIDE FILMS WITH ELEMENTAL IODINE. Bartlett, T. W. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 5 Aug 1974. Contract W-7405-eng-26. 6p. (CONF-740803-5). Dep. NTIS $4.00.

From 32nd annual meeting of the Electron Microscopy Society and Exhibition; St. Louis, Missouri, USA (13 Aug 1974).

The technique consists of placing the metal sample in a petri dish with a few iodine crystals for a few hours or overnight. The container should not be totally closed since some moisture is essential for the reaction to proceed. The sample is removed and lowered slowly into a small container of water. The corrosion film floats on the surface of the water and portions may be picked up with formvar-carbon covered specimen grids. The required time of exposure to iodine varies with the thickness of the oxide film and with the particular metal involved. A typical time for a 500 A film on nickel is 5 to 6 hours, but thin films on aluminum have been removed after 1 hour. The method has been applied to oxide films on aluminum, nickel, steel and magnesium, and to fluoride films on nickel. Very thin films (50 to 100 Å) are removed in large continuous pieces, but thicker films are removed in fragments. (auth)

24534 (LA-5593) COMPATIBILITY OF HAFNALLOYS 105 AND 150 WITH $^{238}PuO_2$. Land, C. C.; Peterson, D. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 9p. Dep. NTIS $4.00.

The compatibility between two Hafnalloys (Hf–Pt–Pd formulations) and $^{238}PuO_2$ was investigated after exposure at 1000°C for 2000 and 5800 h. Hafnalloy samples with and without preapplied surface layers of hafnia were studied. To interpret the oxidation behavior of the two alloys, thermodynamic and diffusion calculations of their reactivities with plutonia were correlated with experimental observations. The two Hafnalloys prove to be unsuitable materials for plutonia storage at 1000°C for 2000 hours or longer, because O and Pu diffuse into the alloy lattice and the container becomes brittle. Calculations indicate that they also would not make suitable containers for plutonia at 800°C. (14 fig) (auth)

24535 (SLA-74-0304) STRESS-CORROSION CRACKING BEHAVIOR OF TWO URANIUM ALLOY ARMOR PENETRATOR MATERIALS. Magnani, N. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 14p. Dep. NTIS $4.00.

The stress-corrosion cracking susceptibility of two uranium alloys proposed for armor penetrators, U-¾ Ti and 1 Quint, was determined. The data showed that both alloys suffer only slight environmental degradation in 100% relative humidity air, but are quite susceptible to cracking in 50 ppM Cl^- solutions. Tests on actual penetrators showed that the residual stresses were not high enough to lead to cracking in either of these environments after 6 months exposure. (7 figures) (auth)

24536 (UCID-15356) CORROSION DAMAGE TO A TUNGSTEN–25 AT. % RHENIUM–30 AT. % MOLYBDENUM CONTAINMENT ALLOY AFTER EXPOSURE TO FLOWING LITHIUM. Tardiff, G. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Sep 1968. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

The corrosion damage sustained by a tungsten–25 at. % rhenium–30 at. % molybdenum alloy after a 1000-h, high-temperature exposure to flowing lithium is reported. Surface microprobe analysis shows that mass transfer of molybdenum occurred by a thermal-gradient mass-transfer mechanism. The molybdenum was affected to a depth of only a few microns. The many 1-mil intrusions into grain boundaries found at the hottest portion of the test capsule (~1450°C) represent the only severe damage discovered in the investigation. Such intrusions, depending on their rate of development beyond 1000 h, would severely limit the use of W–Re–Mo alloys for the containment of dynamic liquid lithium above 1400°C. No adverse effects of the lithium environment on the low-temperature mechanical properties of the containment alloy were observed. (auth)

24537 (UCID-15599) STUDY OF MULBERRY SURFACES BY AUGER AND IEE SPECTROSCOPY. Colmenares, C. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Feb 1970. 26p. Dep. NTIS $4.50.

Samples of Mulberry (an alloy nominally consisting of 90% uranium, 7.5% niobium, and 2.5% zirconium) were studied via Auger and induced-electron-emission (IEE) spectroscopy. Auger data on oxidized Mulberry samples at both room temperature and 150°C indicated that the surface concentration of niobium ranged from 8 to 16 wt % as compared with a bulk concentration of 6.4 wt %. Auger data on the effect of bombarding a Mulberry sample with argon ions qualitatively indicated that the bombardment enriched the niobium and zirconium on the surface of the sample. Auger data on the results of a platinum-marker experiment indicated that when a Mulberry sample was oxidized by pure oxygen, oxygen ions predominantly diffused into the sample rather than uranium ions diffusing out. IEE data on a Mulberry sample came from an oxide film on the surface of the sample rather than from the alloy itself. The uranium in the oxide film was found to have the same oxidation state as the material used in the experiments summarized by Siegbahn. The spectral lines of the niobium and zirconium in the oxide film were shifted in a direction which indicated that the niobium and zirconium were more oxidized than the compounds described by Siegbahn. However, a check of Siegbahn's references failed to turn up any information on the actual oxidation states of the cited compounds. The spectral line of the oxygen in the oxide film was more highly reduced than elemental oxygen, and it displayed an asymmetric shape that may have been caused by two or more unresolved lines. These lines could have been produced either by a distribution in the oxidation states or by a paramagnetic exchange splitting of the core electrons in the oxygen. (auth)

24538 (UNC-5121) POTASSIUM CORROSION IN A REFRACTORY METAL-STAINLESS STEEL SYSTEM UP TO 1600°F. Goldmann, K.; Hyman, N.; McKee, J.; Grossman, H.; Kostman, S.; Minushkin, B. (United Nuclear Corp., White Plains, N. Y. (USA). Development Div.). 30 Apr 1965. Contract AT(30-1)-3078. 207p. Dep. NTIS $13.50.

Declassified 31 Aug 1973.

Corrosion in Nb–1% Zr, type 316 stainless steel, potassium systems was experimentally evaluated under simulated Military Compact Reactor (MCR) conditions. Thirty-one thermal convection loops and one forced circulation loop were operated for 115,000 loop hours. Most loops operated at 1600°F maximum potassium temperature for 5000 h. The effects of variables such as maximum temperatures, potassium purity, velocity, Reynolds number, and surface area ratios were evaluated. Results confirm that Nb–1% Zr and type 316 stainless steel are satisfactory materials for MCR fuel cladding and primary system containment structures, respectively. Surface removal rates from Nb–1% Zr can be held to less than 0.1 mil/y by maintaining a low O content in the potassium. C and N are transferred by the K from the stainless steel to form adherent reaction layers on the Nb–1% Zr. Diffusion of C and N into the matrix is sufficiently slow to maintain adequate structural properties up to 1600°F for 5000 h. Hot-end stainless steel surface removal rates are less than 1 mil/y. Deeper intergranular penetration was observed in some localized heater areas, not typical of stainless steel exposure conditions in the MCR. Tensile testing of sections from a loop which operated for 14,000 h confirmed that the type 316 stainless steel maintained adequate mechanical properties. (44 tables, 59 figures) (auth)

24539 (WAPD-TM-1149) HALOGEN STRESS CORROSION CRACKING OF ZIRCALOY-4 TUBING (LWBR DEVELOPMENT PROGRAM). Busby, C. C.; Tucker, R. P.; McCauley, J. E. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Jul 1974. Contract AT(36-1)-GEN-14. 55p. Dep. NTIS $5.75.

The stress corrosion behavior in the presence of iodine vapor or chlorine gas of unirradiated, recrystallized and stress-re-

lieved Zircaloy-4 as a function of hoop stress, test temperature and contaminant concentration has been investigated using internally pressurized tube specimens. Comparison with similarly tested control specimens (no halogen) shows that at 680 and 750°F as little as 0.5 to 1 mg halogen per dm^2 Zircaloy surface is sufficient to reduce failure time for hoop stresses above 21 to 24 kpsi. Failure time appears to be essentially independent of iodine up to 8 mg/dm^2. At equivalent stress ratios ($\sigma_{applied}/\sigma_{Y.S.}$) with iodine (1) the higher temperature results in shorter failure times over most of the stress range investigated and (2) stress-relieved material generally failed before recrystallization. Failures were typically pinholes except at high stresses where stress rupture occurred. Scanning electron microscopy revealed intergranular failure in recrystallized specimens and the presence of fluted facets in both materials. (auth)

24540 (WARD-NA-3045-11) SODIUM TECHNOLOGY PROGRAM COMPONENT MATERIALS COMPATIBILITY. Quarterly Progress Report for Period Ending April 30, 1974. Ray, W. E. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Aug 1974. Contract AT(11-1)-3045. 20p. AT.

Research on interstitial transfer and sodium effects on mechanical properties is reported. Status of loop operations is given. Data on the diffusivity of carbon in 2¼ Cr-1 Mo steel at 1000 to 1400°F are given. (DLC)

24541 (WCAP-8256) EFFECT OF LOW FREQUENCIES ON THE FATIGUE CRACK GROWTH CHARACTERISTICS OF A533 GRADE B CLASS 1 PLATE IN AN ENVIRONMENT OF HIGH-TEMPERATURE PRIMARY GRADE NUCLEAR REACTOR WATER. Heavy Section Steel Echnology Technical Report No. 35. Mager, T. R.; Landes, J. D.; Moon, D. M.; McLaughlin, V. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1973. 63p. Dep. NTIS $6.25.

Fatigue crack growth rate tests conducted in PWR and BWR primary grade reactor coolant at 288°C on A533 Grade B Class 1 steel (HSST Plate 02) showed an increase in growth rates at a frequency of 1 cpm over previous results obtained at frequencies of 60 cpm and higher. This increase, the general character of the crack growth rate versus the ΔK curve, and the results from fractographic studies, all indicated that stress corrosion cracking might have occurred for this material and environment. However, a specimen loaded statically in a PWR environment showed no static load crack growth. (24 fig, 8 tables) (auth)

24542 LIQUID ALKALI METALS. Proceedings of the International Conference Held at Nottingham, England, April 4-6, 1973. London; British Nuclear Energy Society (1973). 314p. (CONF-730449-).

Forty-five papers were presented at the conference. Forty-four of the papers were previously abstracted in NSA as 30: 2477, 2478, 2539, 2540, 2541, 2591, 2634, 2635, 2636, 2637, 2638, 2639, 2641, 3083, 3084, 3783, 3835, 3836, 3837, 3838, 3839, 3840, 3841, 3842, 3843, 3844, 3845, 3846, 3847, 3848, 3849, 3850, 3851, 3852, 3853, 3935, 3936, 3937, 3938, 3939, 3940, 3941, 3942, and 9124. The paper for which no abstract was prepared is concerned with corrosion of Fe by Na containing O. (JRD)

24543 STUDY OF THE CORROSION OF AUSTENITIC STEELS BY SODIUM USING A SCANNING ELECTRON MICROSCOPE. Borgstedt, H. U. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). pp 279-283 of Fifth European Congress of Corrosion. Paris; Federation Europeenne de la Corrosion ([nd]). (In German).

From 5th European congress of corrosion; Paris, France (24 Sep 1973).

A high magnification scanning electron microscope with a very large depth of field was used to study the corrosion of tubes exposed to sodium in loops for 5000 hours at 600°C. The results of observations on the morphology of deposits resulting from mass transfers are given together with those of analyses effected using x-ray spectrometry. (FR)

24544 CORROSION BEHAVIOR OF NEW Zr-ALLOYS. Tolksdorf, E. (Atomenergikommissionens Forsogsanlaaeg, Riso, Denmark). pp 321-323 of Proceedings of the Fifth European Conference on Corrosion. Rueil-Malmaison; Societe de Chimie Industrielle (1973).

From 5th European conference on corrosion; Paris, France (24 Sep 1973).

The corrosion resistance and hydrogen uptake of eight different zirconium alloys were investigated at 290°C in water and at 400 and 500°C in superheated steam. The alloys contained some of the following additions: V, Fe, Nb, Ta, Cr, Cu, Sn, Ni, and Mg (in amounts not greater than 2.5 wt %). The preparation process for a new and unconventional alloy, Zr plus 1 wt % Mg(O), is described. This alloy showed high corrosion resistance at 290°C in water and at 400°C in superheated steam. (IAA)

24545 Si ADSORPTION ON SINGLE-CRYSTAL FACES OF W. Kiwanga, C. A.; Collins, R. A. (Univ. of Lancaster, Eng.). Phys. Status Solidi (a); 23: No. 1, 209-214(16 May 1974).

Previous studies of silicon on tungsten field emitters were extended to measurements on single-crystal faces. The variation in work function with surface adatom density was determined for several planes. Dipole moments and effective adsorbate polarizabilities were calculated. An attempt to fit the results to a simple point-dipole depolarization model is only partially successful. (auth)

24546 ANODIC OXIDATION OF RHENIUM. Giraudeau, A.; Lemoine, P.; Gross, M. (Univ. Louis Pasteur, Strasbourg). pp 384-385 of Twenty-third Meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).

From 23rd meeting of the International Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972). See CONF-720809-(Absts.).

24547 CORROSION OF STEPWISE DISSOLVING METALS: CORROSION MECHANISM OF INDIUM. Losev, V. V.; Pchelnikov, A. P. (Inst. of Physical Chemistry, Moscow). pp 392-394 of Twenty-third Meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).

From 23rd meeting of the International Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972). See CONF-720809-(Absts.).

24548 ELECTROCHEMICAL BEHAVIOR OF MOLYBDENUM IN SOME CORROSIVE ENVIRONMENTS. Radovici, O.; Matei, P. (Inst. of Physical Chemistry, Bucharest). pp 400-402 of Twenty-third Meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).

From 23rd meeting of the International Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972). See CONF-720809-(Absts.).

24549 DEVELOPMENT OF A FUSED SLURRY SILICIDE COATING FOR THE PROTECTION OF TANTALUM ALLOYS. Packer, C. M.; Perkins, R. A. (Lockheed Palo Alto Research Lab., CA). J. Less-Common Metals; 37: No. 3, 361-378(Sep 1974).

Results are reported of a research program to develop a reliable, high performance, fused slurry silicide protective coating for a tantalum-10 tungsten alloy for use at 1427 to 1538°C at 0.1 to 10 torr air pressure under cyclic temperature conditions. A review of silicide coating performance under these conditions indicated that the primary wear-out mode is associated with widening of hairline fissures in the coating. Consideration has been given to modifying the oxidation products that form on the coating surface to provide a seal for these fissures and to minimize their widening. On the basis of an analysis of the phase relationships between silica and various other oxides, a coating having the slurry composition 2.5 Mn-33 Ti-64.5 Si was developed that is effective in the pressure range of 1 to 10 torr. The performance of this coating was analyzed statistically and an extensive metallographic characterization was conducted to determine mechanisms of protection and wear. (auth)

24550 INVESTIGATION OF THE STRUCTURE OF THE OXIDE FILM ON ZIRCONIUM ALLOYS WITH 2.5 WT.% NIOBIUM BY MEANS OF OPTICAL AND SCANNING ELECTRON MICROSCOPES. Voitekhova, E. A. pp 153-159 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The structure of the oxide film formed on Zr-2.5 wt.% Nb alloys subjected to different thermal processing was studied. After corrosion in water-steam medium at 300°C for 100, 1000, and 3000 h, it was shown that the rate of growth of the oxide film with respect to thickness, the stability of the film, and the presence of splits in the oxides depend on the previous processing of the alloy. The most favorable oxide film is formed on alloys quenched from the β region: cracks are started at times not exceeding 100 h and film thickness less than 2.6 μm. Alloys subjected to thermomechanical processing in which the cracks of the oxide films are started at 1000 h of testing and thickness of about 1.6 μm have better strength. (tr-auth)

24551 HYDRIDATION AND ITS EFFECTS ON THE MECHANICAL PROPERTIES OF ALLOYS OF ZIRCONIUM WITH NIOBIUM, TIN, AND OXYGEN DURING THEIR CORROSION IN AQUEOUS MEDIUM. Tararaeva, E. M.; Murav'eva, L. S.; Ivanov, O. S. pp 212-217 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

During investigation of alloys of Zr with Nb, Sn, and O it was

established that a reduction of the ductility during corrosion in steam at 400°C is connected not only with the amount of hydrides but primarily with their degree of dispersion caused by the composition of the alloy. An increase of the Nb and Sn concentration in the alloys promotes the coagulation of the hydrides, but at the same time oxygen at 1 at.% inhibits it, which reduces the ductility of the alloy. At increased temperatures the embrittling effect of the hydrides appears less because a tendency to a sealing of cracks was observed. (tr-auth)

24552 INVESTIGATION OF 2.25 Cr–1 Mo STEEL FOR FAST NEUTRON REACTORS. Investigation in the Fiscal 1972 Entrusted by Power Reactor and Nuclear Fuel Development Corporation. Hasegawa, M. Tokyo; Power Reactor and Nuclear Fuel Development Corporation (1972). 82p. (In Japanese).

The objective of this investigation was to collect basic data on 2¼ Cr–1 Mo steel as a material for steam generators, piping and other secondary cooling apparatuses for fast neutron reactor plants, and to examine papers on its mechanical behavior in liquid sodium. Another objective investigation was to obtain reference data for R&D as well as engineering use from the collected data. The material test was conducted in a sodium loop. The corrosion, tensile strength, creep, and fatigue test of a number of Cr–Mo steel in sodium were also studied. The bibliography covers the papers from 1960 to the present, and contains the principal papers stored by makers and fabricators as well as JAERI and National Diet Library. (JA)

24553 HIGH TEMPERATURE OXIDATION OF TUNGSTEN WIRES IN WATER VAPOR–ARGON MIXTURES. Harvey, F. J. (Westinghouse Research and Development Center, Pittsburgh). Met. Trans.; 5: No. 5, 1189-1192(May 1974).

The high temperature oxidation of tungsten wires in free convection was measured in water vapor-argon atmospheres in the temperature range between 2450 and 3000°K and in the H_2O partial pressure range between 3.39×10^{-5} and 1.82×10^{-4} atm at 0.789 atm total pressure. The rate of the reaction generally decreases with increasing temperature at constant bulk water vapor pressure. This dependence is similar to that previously measured in O_2-argon and CO_2-argon atmosphere. The overall oxidation reaction is gas transport controlled as demonstrated by supplemental measurements at 0.395 atm total pressure. A volatile oxide counter diffusion model, which has been previously proposed to explain the oxidation in O_2- and CO_2-argon, is in good agreement with H_2O-argon experiments. A comparison of the present results with the previous experiments shows that the model is in agreement with the relative magnitude of the oxidation rates measured in the three oxidizing atmospheres. (auth)

24554 OXIDATION BEHAVIOR OF TD–NiCr IN A DYNAMIC HIGH TEMPERATURE ENVIRONMENT. Tenney, D. R. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Young, C. T.; Herring, H. W. Met. Trans.; 5: No. 5, 1001-1012(May 1974).

The oxidation behavior of TD–NiCr has been studied in static and high-speed flowing air environments at 1100 and 1200°C. The surface oxide topographies and microstructures formed in both types of environments have been characterized and compared to explain some of the observed differences in the oxidation behavior for the two types of tests. It has been found that the stable oxide morphologies formed on the specimens exposed to the static and dynamic environments were markedly different. The faceted crystal morphology characteristic of static oxidation was found to be unstable under high-temperature, high-speed flow conditions and was quickly replaced by a porous NiO "mushroom" type structure. Also, it was found that the rate of formation of CrO_3(v) from Cr_2O_3(s) was greatly enhanced by high gas velocity conditions. The stability of Cr_2O_3 was found to be greatly improved by the presence of an outer NiO layer, even though the NiO layer was very porous. An oxidation model is proposed to explain the observed microstructures and overall oxidation behavior of TD–NiCr alloys. (auth)

24555 CORROSION OF PRASEODYMIUM IN CHLORIDE MELTS. Usov, P. M.; Saratova, G. N. (Ural State Univ., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 7, 1026-1029(1974). (In Russian).

The process of corrosion of Pr in melts of hydroscopic LiCl and KCl consists of two components: a stationary process of self-diffusion because of the reduction of the ions of the alkali metals to subions and a non-steady process of formation of porous films of the oxychloride of two-valent Pr. The chloride melts stabilize the degree of oxidation of the Pr ion, which is 3. From the experimental data an evaluation was made of the thickness of the diffusion layer on the Pr electrode in chloride melts; it is $(1.7 \text{ to } 2.8) \times 10^{-2}$ cm at 873 to 673°K.

24556 CARBON EQUILIBRIUM RELATIONSHIPS FOR AUSTENITIC STAINLESS STEELS IN A SODIUM ENVIRONMENT. Shiels, S. A.; Bagnall, C.; Schrock, S. L. (Westinghouse Electric Corp., Madison, PA). Nucl. Technol.; 23: No. 3, 273-283(Sep 1974).

A technique to measure the "carbon potential" of heat transport system sodium involves the equilibration of low-carbon Type 304 stainless-steel foils at a standard temperature of 704°C. The equilibrium carbon concentration of the foil in ppM is a direct function of the carbon activity of the sodium. Relations between the carbon potential, C_s, and carbon equilibrium values in Types 304 and 316 stainless steel, C_e, at temperatures T were experimentally determined. These correlations allow the surface carbon levels in system components to be predicted without knowing the transporting species or the thermodynamic relationships between the carbon in the sodium and in the steels. The data were applied to the FFTF primary system after making certain assumptions concerning the carbon potential of the FFTF primary sodium. Results suggest that there is little or no driving force for carburization, but that mechanical compensation will be needed for decarburization in some regions. (9 figures, 8 tables) (auth)

24557 PITTING RESISTANCE OF 18% Cr FERRITIC STAINLESS STEELS CONTAINING MOLYBDENUM. Brigham, R. J.; Tozer, E. W. (Endako Mines Ltd., Ottawa). J. Electrochem. Soc.; 121: No. 9, 1192-1193(Sep 1974).

For a stainless steel, there exists a temperature (called the critical pitting temperature, CPT), below which it will not pit in an oxidizing acid chloride solution such as 10% $FeCl_3$. A series of commercial (AISI 430 and Alloy X) and experimental alloys, with Mo content varying from nil to 3%, were tested. Results follow the equation CPT (°C) = 2.5 + 3.5 × % Mo, which is only half that for austenitic steels (CPT(°C) = 5 + 7 × % Mo), but which is consistent with the reduced Mo activity in ferritic phases. (DLC)

24558 QUANTITATIVE DETERMINATION OF OXYGEN IN THIN OXIDE FILMS ON METALS BY ELECTRON-EXCITED X-RAY EMISSION. Mitchell, D. F.; Sewell, P. B. (National Research Council of Canada, Ottawa). Thin Solid Films; 23: No. 1, 109-125(Aug 1974).

Oxide films of known mean thickness, in the range 10 to 1000 Å, have been grown on high purity substrates of aluminum, iron, nickel, niobium, and tantalum. These samples have been irradiated at normal incidence with low energy electrons and the characteristic oxygen Kα x-ray emission measured with the aid of a soft x-ray spectrometer. Using 1800 eV electrons, all the standards have been studied and the O Kα signal-to-background ratio has been determined under controlled conditions. Evaluation of the resulting calibration curves provides data from which oxide film thicknesses from about 10^{-9} g/cm² (submonolayer) to about 10^{-5} g/cm² can be determined for these specific metal/metal oxide systems with good accuracy. Samples have also been examined using electrons of energy between 525 and 4500 eV. From these results a more general experimental relationship between the O Kα signal-to-background ratio, film thickness and electron energy has been derived. This more general relationship, derived from five oxide systems having cations ranging from Z = 13 to Z = 75, is considered to be applicable (within specified limits) to any simple oxide-on-metal system in the film thickness range 0 to 150 Å. (auth)

24559 PLASMA ANODIZATION OF TITANIUM AND MOLYBDENUM. Knorr, K. (Institut Max von Laue–Paul Langevin, Grenoble, France). Thin Solid Films; 23: No. 1, 101-107(Aug 1974).

The plasma anodization of Mo and Ti has been studied using in situ ellipsometry. The oxides were formed in a dc oxygen glow discharge at constant anodization current. Mo was found to give a reproducible oxide layer with an index of refraction $\hat{n}$(Mo oxide) = 2.10 – i0.008. In contrast, the refractive index of the Ti oxide layer varied from sample to sample, with a real part between 2.34 and 2.10 and an imaginary part of approximately 0.04. The growth efficiency and the thickness dependence of the sample voltage were determined and found to be similar to those found in previous work on Nb and Ta. (auth)

24560 PROPERTIES OF ANODIC OXIDE LAYERS FORMED ON NITROGEN-CONTAINING TANTALUM FILMS. Simmons, R. T. (Western Electric Co., Inc., Winston-Salem, NC); Morzenti, P. T.; Smyth, D. M.; Gerstenberg, D. Thin Solid Films; 23: No. 1, 75-87(Aug 1974).

The growth mechanism, dielectric properties, and composition of anodic films on sputtered tantalum–nitrogen alloy films have been studied as a function of nitrogen content from 0 to 27 at. %. For the anodization conditions used both tantalum and oxygen ions were mobile during oxide growth while the nitrogen remained essentially stationary. The result was a nitrogen-free region in the oxide adjacent to the oxide–electrolyte interface. Incorporation of nitrogen into the anodic film caused a reduction of its density and required higher fields to produce oxide growth at a given ionic cur-

rent density as compared with films grown from pure β-tantalum. For nitrogen contents up to 21 at. % in tantalum the dielectric constant of the anodic oxide decreased linearly as a function of density. Structural changes in the as-sputtered tantalum films observed while the nitrogen content was increased from 0 to 27 at. % did not have an effect on the anodization mechanism. (auth)

Preparation and Fabrication

Refer also to abstracts 23581, 24482, and 24511.

24561 (AD-776293/3) INVESTIGATION OF PARAMETERS INVOLVED IN METAL PROCESSING OPERATIONS. Final Report, 16 December 1970–15 October 1973. Abson, D. J.; Gurney, F. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1973. Contract F33615-71-C-1163. 74p. (AFML-TR-73-281). NTIS $3.75.

The findings of several investigations involving the influence of process variables on the production of shapes with specified geometry and controlled microstructure are summarized. The studies included: the extrusion consolidation of pre-alloyed metal powders (7075 aluminum and Rene 95); a refinement of the analysis and application of the ring compression test; the use of hardness testing to evaluate the strength of hot deformed product; investigations of the effect of processing variables on extruded product and extrusion pressures; the fabrication of a heated die forging system and a preliminary investigation of lubricants; an analysis of published flow stress data for Ti–6Al–4V; studies of grain growth in titanium-base alloys; and a comparison of grain boundary and sub-boundary strengthening in aluminum. (GRA)

24562 (IS-M-23) USE OF INERT ATMOSPHERES IN THE PREPARATION AND HANDLING OF HIGH PURITY RARE EARTH METALS. Beaudry, B. J.; Palmer, P. E. (Ames Lab., Iowa (USA)). 1974. 9p. (CONF-741002-2). Dep. NTIS $4.00.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

The results of studies on the preparation of the rare earth metals by the calcium reduction of the rare earth fluorides under various conditions will be presented. It was shown that the major role of an inert atmosphere during the room temperature handling operations is to keep the calcium from oxidizing and to protect the as-reduced metal from the air. The effect of the reactants' purity on the purity of the final product is also discussed. Data on the contamination of rare earth metals during cold-working and heat-treating procedures are presented. Methods to minimize contamination from the various mechanical operations and heat treating are described. (auth)

24563 (LA-5665-MS) LIQUID PHASE SINTERING OF W–Ni–Fe. Zukas, E. G.; Levinson, L. S. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1974. W-7405-eng-36. 13p. Dep. NTIS $4.00.

During the liquid-phase sintering of W–Ni–Fe composites, solid tungsten single crystal spheroids are surrounded by a molten matrix of W–Ni–Fe. These spheroids grow in a regulated manner if either the sintering time is increased or if the sintering temperature is raised. Since the slope of the log diameter-log time plot is ⅓, and should remain constant because it is based on the dissolution of tungsten from the small spheroids with simultaneous precipitation of tungsten from the molten matrix onto the larger spheroids, the behavior of any new composite composition should be characterized by just one sintering experiment in a calibrated temperature gradient. A low matrix volume composite (95% W–3.5% Ni–1.5% Fe) sintered in a temperature gradient showed anomalous behavior in that the spheroid size did not decrease with decreasing temperature in the gradient, and the average spheroid size was much larger than expected based on constant sintering temperature experiments. Furthermore, composites of higher matrix volume (92% W, or 89% W with the same nickel to iron ratio) behaved differently in that they had a smaller average spheroid size at the lower temperatures in the gradient. Since copper and tungsten are mutually insoluble, and since copper is dissolved readily by the matrix, copper was injected into both presintered and liquid-phase sintered composites to follow matrix flow during subsequent sintering treatments. The copper concentration decreased with distance from the hot zone for high volume matrix alloys, pretty much in accordance with liquid diffusion theory, but in the low volume matrix alloys where the volume of solid tungsten spheroids is higher and should impede matrix motion even more, the copper was distributed almost uniformly throughout the matrix that was molten during the sintering. Since the spheroid compositions, matrix compositions, matrix densities, spheroid surface tensions, matrix surface tensions, and most other properties are the same for all specimens, the seemingly anomalous behavior is attributed to some mechanism dependent on capillary action since the decreased pore radius between the spheroids in the low matrix volume composites increases the capillary forces by about 25%. (auth)

24564 (RMI-L–64) OPTIMUM TOOL DESIGN STUDY FOR DEPLETED URANIUM EXTRUSION. Brewer, N. F.; Cline, J. H. (RMI Co., Ashtabula, Ohio (USA). Extrusion Plant). Feb 1974. Contract AT(30-1)-1405. 14p. Dep. NTIS $4.00.

The design variables studied were die approach radius, die bearing length, and cone approach angle. 0.141% ^{235}U depleted uranium billet stock was used. Extrusion constants (K-factor) and ovality were measured. Results indicate that present tooling design is adequate. (DLC)

24565 (Y-DA-5833) OPTICAL METALLOGRAPHY OF TANTALUM SINGLE CRYSTALS. Dobbins, A. G.; Snyder, W. B. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). 20 May 1974. Contract W-7405-eng-26. 17p. (CONF-740812-1). Dep. NTIS $4.00.

From 7th annual International Metallographic Society technical conference; Gatlinburg, Tennessee, USA (4 Aug 1974).

A method is described for polishing tantalum single crystals to reveal grain structure without etching or using elevated temperatures to induce epitaxial oxide coatings. This method provides a good sample for optical metallography in studying the recrystallization of tantalum single crystals and for screening samples for recrystallization before undertaking examinations by x-ray diffraction and transmission electron microscopy. (auth)

24566 DETERMINING THE QUALITY OF ZIRCALOY CLADDING TUBES USING STATISTICAL EVALUATION OF THE MATERIALS PROPERTIES. Kleibeler, H. J.; Richter, H. (Vereinigte Deutsche Metallwerke A. G., Duisburg (F. R. Germany)). Z. Metallkd.; 65: No. 5, 341-345(May 1974). (In German).

9 figs.; 2 tabs.; 7 refs.

The determination of uniformity of fabrication, early recognition of degradation in the material, and elimination of losses in quality are possible with the application of statistical evaluation methods to the testing of Zircaloy cladding tubes. Typical measurements include mechanical and corrosion tests, and the determination of surface roughness and factors affecting the orientation of the zirconium hydride precipitates. The influence of small changes in fabrication parameters can be clearly seen using statistical methods. (GE)

24567 STUDY ON THE WELDING OF THE STAINLESS STEEL FOR THE STRUCTURE OF FAST BREEDER REACTORS. II. Problems on Welding Work and Application. Tokyo; Japan Welding Engineering Society (1972). 156p. (In Japanese).

From the fiscal year 1969 on, concerning reactor containment vessels and piping, research was conducted to develop the welding techniques for austenitic stainless steel. Welding conditions and joint performance were investigated emphasizing (1) effects of welding after cold working on the high temperature property of welded parts, (2) mechanical characteristics of welded parts and number of pass and temperature, (3) effect of heat treatment after welding on residual stress and corrosion resistance, (4) various properties of welded joints of stainless steel castings, and (5) change of joint performance during long operation under high temperature circumstance. With regard to (1), the test plates made by arcwelding were subjected to creep-rupture test, Charpy test and bending test. The examination (5) is the most important item, and various tests were performed, such as the embrittlement of welded parts by the change of ferrite content, embrittlement by the change of chrome content, the high temperature strength of welded parts with different carbon content, and the relation of fatigue strength with the change of metallic structure. As for SUS 27 steel welded joints, enough soundness of structures was affirmed, and the long operation at 550°C was confirmed to be safe. But it was found that the welded joints of SUS 32 steel were not so reliable as SUS 27. As for SUS 32 steel, more elaborate study must be performed on the limitation of ferrite component at the time of welding. (JA)

24568 THERMOPLASTIC MOLDING OF PRODUCTS FOR PONY LADLES IN CONTINUOUS STEEL CASTING. Kainarskii, I. S.; Orlova, I. G.; Grinberg, Ya. M. (Scientific Inst. for Refractories, Kiev). Refractories (USSR) (Engl. Transl.); 14: No. 7-8, 493-499(1973).

Translated from Ogneupory; 14: No. 8, 31-39(Aug 1973).

Process and equipment for continuous steel casting is described. The process incorporates a thermoplastic method of molding zircon and ZrO_2 hollow ware items having stable dimensions and high porosity. These properties lengthen their useful life as batchers in the pony ladles used in continuous steel casting. (JRD)

24569 INTERRELATIONSHIPS BETWEEN PROCESS PARAMETERS, STRUCTURE, AND PROPERTIES OF CVD TUNGSTEN AND TUNGSTEN-RHENIUM ALLOYS. Holman, W.R.; Huegel, F.J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). J. Vac. Sci. Technol. 11: No. 4, 701-708 (July 1974).

The development of CVD techniques for fabricating free-standing tungsten and tungsten-rhenium alloy structures is reviewed. Relationships between plating parameters, kinetics, morphology, microstructure, and properties of thick polycrystalline deposits are discussed. It is emphasized that porosity may be grown into the grain boundaries when the depostition rate is controlled by gas phase diffusion, and that fully dense deposits are generally obtained when the rate is limited by a surface process. The origin and control of many of the microstructural features peculiar to CVD are also discussed. (auth)

24570 STRUCTURE AND PROPERTIES OF ARC-SPRAYED TITANIUM, NIOBIUM, AND MOLYBDENUM COATINGS. Steffens, H.; Müller, K. (AFAM, 282 Bremen-Lesum, Lesumer-Heestr. 36, West Germany). J. Vac. Sci. Technol. 11: No. 4, 735-740 (July 1974).

Since density, ductility, and homogeneity of titanium coatings have a special significance by reason of the use of such coatings in the fabrication of chemical apparatus and equipment, metallurgical tests were conducted with a view to determining the effect of the gas atmosphere on these properties. The various tests yielded the following findings. Photographs of the structure of the coatings taken through a light-optical and electron-optical microscope reveal that arc-sprayed titanium coatings are completely dense, crack-free, and homogeneous if they have been applied in a shielding gas atmosphere of highest-purity argon. Adding reactive gases such as nitrogen to the shielding gas atmosphere causes inhomogeneous, brittle, and cracked coatings to be produced which are characterized by segregations in the direction of the temperature gradient. Examination under a scanning electron microscope and a photoemission electron microscope reveals the presence of dentritic nitrides in nitrated arc-sprayed titanium coatings. Structural examinations conducted with an x-ray diffractometer reveal that arc-sprayed titanium applied in an inert gas atmosphere does not contain foreign phases, which means that it is free from oxides and nitrides and may hence be regarded as homogeneous. By reason of the high cooling rate obtaining in thermal spraying, the transformation of the lattice structure of the titanium from the β-phase into the α-phase which, in equilibrium, occurs at 882°C, is partially suppressed so that the spray coatings contain unstable β-titanium in addition to the stable α-titanium. As the partial pressure of the nitrogen increases the super-cooled β-phase of the titanium decreases in proportion to the increase in α-Ti stabitization. The angle shift of the diffraction reflections already noted in spraying in an atmosphere of highest-purity argon, increases with rising nitrogen content since, for one thing, the internal tensile stresses increase with increasing embrittlement of the structure and, for another, the interstitial solution of the nitrogen expands the mixed crystal. Microhardness measurements prove that the hardness of the coatings is low if gas/metal reactions are avoided, whereas the rising partial pressure of reactive gases causes the hardness to increase markedly, which is an indication of decreased ductility of the coatings. Electrochemical measurements prove that arc-sprayed coatings applied in an inert gas atmosphere exhibit the same behavior as the starting materials. The usability of such coatings as a protection against aggresive media has therefore been demonstrated. (auth)

24571 A STUDY OF THE BONDING MECHANISM OF SPRAYED COATINGS. Kitahara, S. (Welding Division, National Research Inst. for Metals 3-12, 2-Chome, Nakameguro, Meguro-ku, Tokyo 153, Japan); Hasui, A. J. Vac. Sci. Technol. 11: No. 4, 747-753 (July 1974).

The adhesive mechanism of plasma jet-sprayed nickel, chromium, molybdenum, tantalum, and tungsten coatings on aluminum and mild steel substrates was investigated. The compositions of the boundary layers between the coatings and the substrates were studied using x-ray diffraction. Experiments on the bonding behavior between substrates and nickel drops heated by the levitation melting process were also performed. The results of the experiments show that: (i) the substrate surface is melted by the sprayed particles, and a boundary layer which consists of an intermetallic compound consisting of the elements of the coating and substrate materials is formed between the coating and the substrate; (ii) this layer is necessary to improve the adhesion between the sprayed coating and the substrate; (iii) the adhesive mechanism between the sprayed coating and the substrate surface and the composition of the boundary layer were confirmed by a liquid nickel-drop experiment. (auth)

24572 APPLICATIONS OF THE METALLIZATION PROCESS BY PLASMA IN THE NUCLEAR RESEARCH FIELD. Cafaggi, E.; Debelli, S. (CNEN, Casaccia, Italy). Met. Ital.; 66: No. 5, 260-262(May 1974). (In Italian).

New applications of metallization by plasma have been carried out aiming to the solution of technical problems arising in the course of research. Favorable results obtained in cases such as molybdenum deposition on Zircaloy 2; ceramic material deposition on copper in order to obtain a heavy duty electrical insulation deposition of pure alumina on quarz; and junction of ceramic pipes by means of metallic materials are outlined. Besides the solution of some specific problems, the tests have shown that by carrying on proper research, the lamination process by plasma is adaptable to development in other technical fields. (tr-auth)

24573 THERMAL TREATMENT AND STRUCTURE OF STAINLESS STEEL WITH 27% Cr, 4% Ni, AND 1.5% Mo. Ramous, E. (Univ., Padua); Giordano, L.; Libondi, G. Met. Ital.; 66: No. 4, 201-204(Apr 1974). (In Italian).

Results obtained from a study of the influences of the conditions and the manufacture and thermal treatment on stainless steel 27% Cr-4% Ni-1.5% Mo. The manufacture of this steel must be carried out accurately in order to avoid excessive enlargement of the grains. The final treatment of recrystallization must be carried out at a temperature of about 950 to 1000°C to eliminate phase o. Higher temperatures bring about the enlargement of the grain, a decrease in the quantity of austenite and a major precipitation of the carbides which however are always present in the structure of this type of steel. (auth)

24574 ACTIVATION OF THORIUM SINTERING BY THE IRON GROUP METALS. Zaborenko, K. B.; Os'kina, T. E. Vestn. Mosk. Univ., Ser. II. Khim.; 15: No. 3, 364-365(1974). (In Russian).

The activated sintering of thorium has been investigated. Iron, cobalt and nickel were utilized as alloying components. The kinetics of shrinkage was recorded by dilatometer. The addition of activating agents in thorium was found to reduce the energy of activation of sintering. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 23592, 23697, 23907, 24514, 24751, 24752, 25871, and 25878.

24575 (AD-772836/3GA) RESEARCH TO INVESTIGATE THE AGING CHARACTERISTICS OF SAMARIUM COBALT MAGNETS. Semiannual Report, 1 January-30 June 1973. Mildrum, H. F.; Strnat, K. J. (Dayton Univ., Ohio (USA). Research Inst.). Sep 1973. Contract F33615-72-C-1795. 123p. (UDRI-TR-73-45; AFML-TR-73-249). NTIS $4.50.

The principal objective of the program is to investigate the aging stability of commercially produced sintered SmCo5-based permanent magnets from two domestic sources. Results of measurements of engineering design parameters are reported, although many tests are still in progress. Investigations were conducted thus far on cylindrical magnet samples having a $B_dH_d = 1$. These have included: natural air and vacuum aging at room temperature; natural air aging at room temperature after a prestabilizing heat treatment ("thermal knockdown"); and accelerated thermal air aging at temperatures between 150 and 300°C. Reversible temperature coefficients and irreversible losses have been measured during repeated thermal cycling at -100 to +300°C. Changes in the hysteresis loop shapes and demagnetization curves before and after exposure are also presented and discussed. (GRA)

24576 (AD-775717/2) INVESTIGATION OF THE DYNAMIC SUSCEPTIBILITY OF Nd(1-X) Sm(X)Co_5 SINGLE CRYSTALS AND THE EFFECT OF HYDROGEN ABSORPTION. Final Technical Report, 15 February-14 August 1973. Maartense, I. (Manitoba Univ., Winnipeg (Canada). Dep. of Physics). Oct 1973. 50p. (AFML-TR-73-250). NTIS $3.25.

Measurements are reported on the ac susceptibility of Nd(1-x) Sm(x)Co_5 single crystals, with x = 0, 0.25, 0.5, 0.75 and 1.0. The spin reorientation temperature, which occurs at 281°K in $NdCo_5$, is found to occur at 167°K and approximately 140°K in the alloys with x = 0.25 and 0.5 small quantities of absorbed hydrogen raise these temperatures by a few degrees. When a swept biasing field is reversed, the presence of an internal critical field is noted as well as rate dependent losses which cause an apparent drop in the susceptibility. The presence of hydrogen causes a doubling of this field as well as an increase in the losses, which are associated with strong barkhausen discontinuities. In $NdCo_5$ a strong hydrogen-induced relaxation characterized by an activation energy of 0.4 eV is seen below 220°K. Additional relaxations occur near 375 and 720°K. (GRA)

24577 (AD-775719/8) MATERIALS PROCESSING OF RARE EARTH-COBALT PERMANENT MAGNETS. Final Report, 1 January-30 September 1973. Jorgensen, P. J.; Bartlett, R. W. (Stanford Research Inst., Menlo Park, Calif. (USA)). Jan 1974. 138p. (AFML-TR-74-2). NTIS $4.75.

The $RECo_5$ intermetallic compounds, where RE stands for one of the light rare earths, show a high magnetic saturation and very high magneto-crystalline anisotropy. Alternative materials processing techniques were investigated in an effort to develop improved powder preparation methods: (1) ball milling in a non-reactive liquid, (2) plasma spheroidization of alloy particles, (3) plasma annealing without melting alloy particles, (4) electro-deposition of rare earth–cobalt alloys, and (5) metallothermic reduction of rare earth–cobalt alloys. The primary material used in this study was $SmCo_5$ but studies were also made on $PrCo_5$ and $MMCo_5$ containing major amounts of cerium. Oxidation and sintering of $SmCo_5$ were discussed in detail. (GRA)

24578 (AD-776009/3) EFFECTS OF INTERFACE PHENOMENA ON THE MECHANICAL BEHAVIOR OF METALS. Starke, E. A. Jr.; Livesay, B. R. (Georgia Inst. of Tech., Atlanta (USA)). Feb 1974. 22p. (AFOSR-TR-74-0304). NTIS $3.00.

Research is summarized on the relations of various interface parameters with the mechanical behavior of metals. The broad research program includes study of such parameters as differential modulus, crystal structure, degree of order, stacking fault energy, and type of interface, and their effects on yield strength, work-hardening, low-cycle fatigue, and friction and wear. Descriptions are included on how the objectives of the program are achieved. (GRA)

24579 (AD-776018/4) BULK AND SURFACE PROPERTIES OF METALS. Final Report. Kleinman, L. (Texas Univ., Austin (USA). Dept. of Physics). Jan 1974. 12p. (AFOSR-TR-74-0248). NTIS $3.00.

The energy bands of VO_2 in both the metallic and semiconducting phases were calculated demonstrating that the metal–insulator transition can be understood in simple one-electron theory. It is demonstrated that if one takes the proper combination of the degenerate wave functions of the star of vector K, the orbital symmetry rules for chemisorption can always be satisfied. The gradient term of the Kohn–Sham exchange is derived plus correlation potential showing that Sham's result for exchange alone was incorrect. A hydrodynamic solution of the Boltzmann equation for surface plasmons was obtained. Using a new method, the energy bands and charge density for a (100) lithium film were calculated and a method for obtaining nearly self-consistent potentials in metal films is developed. This potential was used for the calculation of surface states in the (100), (110), and (111) faces of aluminum. (GRA)

24580 (AD-776020/0) MAGNETIC NEUTRON DIFFRACTION STUDIES OF PrCo5 AND SmCo5. Final Report. Morash, K. R.; Averbach, B. L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Metallurgy and Materials Science). Nov 1973. Contract F33615-71-C-1323. 71p. (AFML-TR-73-274). NTIS $3.75.

PrCo5 powder samples were examined by x-ray and neutron diffraction in order to determine the magnetic moments on the Pr and Co atoms. These data were analyzed assuming different spin orientation models. The only model which gave reasonable results was one of ferromagnetic coupling of the Pr and Co moments with the moment lying along the c-axis. The moments, in bohr magnetons, calculated in this way, are listed in tables for various temperatures. A SmCo5 powder sample using a ^{154}Sm isotope was also studied by neutron diffraction and by use of the vibrating sample magnetometer. (GRA)

24581 (AD-776023/4) LAMELLAR COMPOSITES FORMED BY SPUTTER DEPOSITION. Semiannual Technical Report. Busch, R. A.; Patten, J. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1973. Contract F44620-73-C-0071. 26p. (AFOSR-TR-74-0245).

The initial work on the two concepts of the formation of lamellar composites by sputter deposition is presented. (GRA)

24582 (AED-CONF-74-089-040) MACROSCOPIC DEFORMATIONS OF NIOBIUM MONOCRYSTALS CAUSED BY ALTERNATING LOAD. Neumann, R.; Neumann, P. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e. V., Porz-Wahn (F. R. Germany). Inst. fuer Werkstoff-Forschung; Max-Planck-Institut fuer Eisenforschung, Duesseldorf (F. R. Germany)). 1974. 8p. (In German). INIS.

From spring meeting of the Arbeitskreis Festkoerperphysik of the Deutsche Physikalische Gesellschaft e. V.; Freudenstadt, F. R. Germany (1 Apr 1974).

6 figs.; 1 tab.

Alternating load deformation experiments on Nb single crystals causing change of shape due to asymmetric slipping on ⟨211⟩ planes. (GE)

24583 (CONF-741002-1) PREPARATION AND DETERMINATION OF THE MELTING POINT AND PHASE TRANSFORMATION TEMPERATURES OF ^{147}Pm METAL. Angelini, P.; Adair, H. L. (Oak Ridge National Lab., Tenn. (USA)). 1974. 14p. Dep. NTIS $4.00.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

The Pm metal was prepared by reduction of promethium oxide with Th metal at 1300°C and volatilization of Pm metal at 1600°C. The melting point and phase transformation temperatures of Pm metal were found to be 1042 ± 3°C and 890 ± 5°C, respectively. The ratio for the heat of the high-temperature transformation to the heat of fusion was determined to be 0.415. (auth)

24584 (COO-2119-12) EXPERIMENTS IN HIGH VOLTAGE ELECTRON MICROSCOPY. Progress Report, October 31, 1973–31 July 1974. Mitchell, T. E.; Das, G.; Kenik, E. A.; Sklad, P. S. (Case Western Reserve Univ., Cleveland, Ohio (USA). Div. of Metallurgy and Materials Science). 1 Aug 1974. Contract AT(11-1)-2119. 13p. Dep. NTIS $4.00.

Conditions for the formation of voids in irradiated foils are described. The important role of dislocations acting as biased sinks for interstitials is emphasized. However, it is found that in heavily cold-worked metals, dislocation climb is inhibited so that swelling due to void formation is inhibited. Results are summarized for several metals. The effects of irradiation on precipitation and recrystallization were also investigated. Radiation damage in ceramic oxides (quartz, alumina) is also being studied. (44 references) (DLC)

24585 (COO-3084-29) COMBINED MACROSCOPIC AND MICROSCOPIC APPROACH TO THE FRACTURE OF METALS. Technical Progress Report, July 1973–June 1974. Gurland, J.; Rice, J. R. (Brown Univ., Providence, R. I. (USA). Div. of Engineering). Jul 1974. Contract AT(11-1)-3084. 13p. Dep. NTIS $4.00.

The problem of interpreting the macroscopic toughness parameters in terms of the deformation and fracture processes at a macroscopic crack is being actively pursued in two directions: (1) A recently developed incremental finite-element program for problems of arbitrarily large plastic-elastic deformations has been applied successfully to the first of a series of accurate analyses of large deformation processes in the crack tip region, and (2) Studies of the microscale mechanisms of cleavage initiated rupture at the crack tip in irradiated pressure vessel steel and in spheroidized carbon steels continue to justify the previously stated fracture propagation criteria, namely that a critical local stress level must be achieved in front of the crack and that this level must prevail over a significant microstructural size scale. Work is continuing as well on models for ductile rupture by nucleation and growth of cavities and on particle strengthening of steels. A new study was initiated on diffusive mechanisms of crack growth along grain boundaries at elevated temperatures, with interesting results indicating that the crack growth is limited not by the time-limiting factor in rupture but by the critical stress conditions at the crack tip as affected by the time-dependent overall deformation. (auth)

24586 (DP-MS-73-68) EFFECT OF HYDROGEN ON METALS. Louthan, M. R. Jr. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). [nd]. Contract AT(07-2)-1. 23p. (CONF-740923-1). Dep. NTIS $4.25.

From process industries corrosion short course meeting; St. Louis, Missouri, USA (9 Sep 1974).

Hydrogen embrittlement of metals is separated into three categories: embrittlement resulting from blister formation, embrittlement from hydride formation, and generalized hydrogen embrittlement. The causes and mechanisms are discussed, and guides to select materials to resist this phenomenon are included. (14 figures, 59 references) (auth)

24587 (DREV-TN-2098/74) EFFECT OF RESIDUAL IMPURITIES ON THE DUCTILITY OF α–URANIUM. Drolet, J. P.; Martel, Y. (Defence Research Establishment Valcartier, Courcelette, Quebec (Canada)). Feb. 1974. 13p. (PD-17431). Dep. NTIS (US Sales Only) $4.00.

The influence of residual impurities on the ductility of unalloyed uranium has been studied by measuring elongation, reduction in area, and hardness. It is shown that the ductility increases with decreasing residual impurities. Maxima of 40% elongation and 35% reduction in area have been measured after 18 hours annealing at 500°C. A discussion of the influence of impurities in terms of the formation of precipitates, the creation of athermal stresses, and segregation to grain boundaries is given. (CA)

24588 (IS-3346(Pt. 1)) COMPILATION OF EXPERIMENTAL WORK ON THERMAL EMITTANCES OF MATERIALS. Part I. Metals. Baria, D. N.; Bautista, R. G. (Ames Lab., Iowa (USA)). Apr 1974. Contract W-7405-eng-82. 308p. Dep. NTIS $18.50.

A compilation of the experimental work on thermal emittances

of metals reported in the literature through 1972 are presented along with a brief review of the various experimental methods available for thermal emittance determinations. An extensive bibliography of about 360 references is included. (DLC)

24589 (IS-M-22) LOW TEMPERATURE PHYSICAL PROPERTIES OF ALLOTROPICALLY PURE α- AND β-CERIUM. Gschneidner, K. A. Jr.; Koskimaki, D. C.; Finnemore, D. K. (Ames Lab., Iowa (USA)). 1974. 9p. (CONF-741002-4). Dep. NTIS $4.00.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

The preparation of pure α- and β-Ce is described. The heat capacity and magnetic susceptibility were measured for the two materials down to 1.5°K. (DLC)

24590 (KAPL-M-7358) RELATING PARTICLE AND CONTINUUM MODELS FOR SMALL ELASTIC DISPLACEMENTS IN A CRYSTAL OF ARBITRARY GEOMETRY. Brudnoy, D. M. (Knolls Atomic Power Lab., Schenectady, N. Y. (USA)). 25 Jan 1974. Contract W-31-109-eng-52. 39p. Dep. NTIS $5.00.

The general formalism of elastic deformation is treated without making any assumptions regarding the form of the matrix A_{ij}. After dispensing with some required definitions, the relationship between elastic constants and potential energy function is derived for arbitrary crystal geometry. The cubic and hcp crystals are brought as illustrative examples. The limit in which the continuum model equations of motion describe particle displacements is derived. The transformation properties of the stress tensor and elastic modulus tensor from unstrained to strained systems are considered. (MCW)

24591 (LA-UR-74-973) METASTABLE FCC SOLID SOLUTIONS IN Ce-Pu ALLOYS QUENCHED RAPIDLY FROM THE MELT. Giessen, B. C.; Struebing, V. O.; Elliott, R. O. (Northeastern Univ., Boston, Mass. (USA); Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract AT(11-1)-3395. 10p. (CONF-741002-3). Dep. NTIS $4.00.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

Single-phase, metastable Ce-Pu alloys have been produced over the complete composition range by splat-cooling. Three fcc Cu-Al type phases can be distinguished: γCe(Pu) solid solutions, a metastable phase designated α_1Ce(Pu) between ~ 20 and 75 at.% Ce, and δ Pu(Ce) solid solutions with lattice parameters which extrapolate to that of αCe. As inferred from lattice parameter data, a sudden electronic transition from trivalent γCe to that of a higher valent α_1Ce occurs at ~ 75 at.% Ce. With increasing Pu content, a further, gradual Ce valence increase to the valence of α-Ce was observed. (auth)

24592 (LBL-2765) EFFECT OF DOPING ON THE RESONANCE RAMAN SCATTERING IN InSb NEAR THE E_1 TRANSITION. Yu, P. Y.; Shen, Y. R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 5p. (CONF-740722-2). Dep. NTIS $4.00.

From 12th international conference on the physics of semiconductors; Stuttgart, F. R. Germany (15 Jul 1974).

Resonant Raman Scattering (RRS) of highly doped InSb at the E_1 transition has been measured. Increase in impurity concentration broadens and shifts the RRS peaks towards lower energies and changes the peak height of the surface-field-induced (SFI) LO phonon and 2LO phonon curves. Results suggest an alternate explanation for the donor concentration dependence of I(LO)/I(TO)(I(LO) and I(TO) are Raman intensities of the SFI LO phonon and TO phonon respectively) observed by Pinczuk and Burstein. (auth)

24593 (LFEN-151(a)) EFFECT OF THE STRUCUTRE OF ZIRCALOY-2 ON ITS MECHANICAL PROPERTIES. Loureiro, A. P. (Junta de Energia Nuclear, Sacavem (Portugal). Lab. de Fisica e Engenharia Nucleares). 1973. 48p. (In Portuguese). Dep. NTIS (US Sales Only) $5.50.

A study was conducted of the correlation between structural features (including texture, nature and size of the grains, and degree of cold forming) and the mechanical properties exhibited by Zircaloy-2. A survey is made on the structures in products made of Zircaloy-2, followed by an account of the corresponding mechanical properties. The later is determined through tests carried out prior to subjecting the material to the corrosion and radiation conditions prevailing in reactors. Emphasis is placed on the most advisable treatments to obtain the adequate strucutres for each application. (auth)

24594 (ORNL-4971) HEAVY-SECTION STEEL TECHNOLOGY PROGRAM SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING AUGUST 31, 1973. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 111p. Dep. NTIS $5.45.

Research directed to extending and developing the technology for quantitatively assessing margins of safety against fracture of the primary containment systems of reactors is reported. Results are summarized in sections devoted to investigations of unirradiated steels, investigations of irradiated steels, and investigations of pressure vessels and piping. (JRD)

24595 (ORNL-TM-2482) EFFECT OF ALLOY ADDITIONS AND HEAT TREATMENTS ON THE MECHANICAL PROPERTIES OF U-0.5% Ti ALLOY. Federer, J. I. (Oak Ridge National Lab., Tenn. (USA)). Feb 1969. Contract W-7405-eng-26. 38p. Dep. NTIS $5.00.

Specific amounts of C, Fe, Ni, Si, Y, and H were added to a base U-0.5 wt % Ti alloy. The tensile properties of the alloys in various heat-treated conditions were then compared to the properties of the base alloy in a similar condition. In gamma-quenched alloys tested at 25 and 600°C, carbon contents of 0.014 and 0.028% did not substantially affect properties, although the effects were mostly detrimental. Si contents of 300 and 400 ppM caused small changes in properties similar to those caused by C, except that the elongation at 600°C was greatly increased. Fe, Ni, and Y each increased the yield and tensile strengths of gamma-quenched alloys; however, Fe (340 ppM) was effective at both 25 and 600°C, while Ni (700 ppM) was mostly effective at 25°C, and Y (0.10%) was mostly effective at 600°C. Each of these elements decreased elongation at 600°C. Aging the base alloy and alloys containing Fe and Ni additions within the alpha range resulted in a further increase in strength at test temperatures of 25 and 400°C. Hydrogen in the range 8 to 14 ppM weakened and embrittled alloys tested at 25°C. Bend testing at 25°C of the base alloy containing an electron-beam weld-fusion zone showed that cracking originated in the weld at much lower strains than had occurred prior to failure in tensile tests of unwelded specimens having the base alloy composition. (9 tables, 11 figures) (auth)

24596 (ORNL-TM-4620) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1974. Patriarca, P. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 163p. AT.

Research and development results are presented on Eu_2O_3 absorber materials, steam generator and heat exchanger materials, properties of structural materials, and properties of weldments for LMFBR. (JRD)

24597 (RD/B/N-3024) METALLOGRAPHIC EXAMINATION OF STEEL FRICTION SPECIMENS RUBBED IN HELIUM-BASED ATMOSPHERES. Parry, A. A.; Palmer, J. E. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Apr 1974. 11p. Dep. NTIS (US Sales Only) $4.00.

Four steels were rubbed on themselves in helium alone and in helium and carbon dioxide at up to 500°C. They were a mild steel, an austenitic stainless steel, a nitrided steel, and a tool steel. Surface and subsurface effects revealed by metallography are discussed. The mild and stainless steels showed damage extending to about 40 μm below the rubbed surface, and considerable thickness of transferred and work hardened material. The much harder nitrided and tool steels showed almost no subsurface damage, and very minor amounts of metal transfer. The structural and oxidation implications of surface cracks and damage are discussed briefly. (auth)

24598 (RDT-M-5-1T(7-74)) STAINLESS STEEL PLATE, SHEET, AND STRIP (ASME SA-240 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Jul 1974. 12p. RSO.

This standard supersedes the Jan. 1972 issue of RDT-M-5-1T, and covers Cr and Cr-Ni stainless steel plate, sheet, and strip for nuclear and associated applications. Additions to ASME SA-240 are given. (DLC)

24599 (RISO-295) QUANTUM MECHANICAL OPERATOR EQUIVALENTS AND MAGNETIC ANISOTROPY OF THE HEAVY RARE EARTH METALS. Danielsen, O. (Danish Atomic Energy Commission, Risoe. Research Establishment). Aug 1973. 222p. Dep. NTIS (US Sales Only) $14.25.

Thesis. Submitted to Technical Univ., Lyngby, Denmark.

A tensor operator formalism that in a convenient way describes the interactions of magnetic systems is treated. Further, a creation operator and annihilation operator formalism describing the excited states of magnetic systems is introduced. On this background, temperature laws of the magnetic anisotropy of the heavy rare earth metals are calculated. The temperature dependence of the spin wave spectrum and of the spin wave energy gap of the heavy rare earth metals is also calculated. (10 tables, 16 figures) (auth)

24600 (SAND-74-8207) EXAMINATION OF SEVERAL HIP, P-1 BERYLLIUM MODIFICATIONS. Odegard, B. C. (Sandia

Labs., Livermore, Calif. (USA)). Aug 1974. Contract AT(29-1)-789. 23p. Dep. NTIS $4.25.

Modifications to the standard CIP/HIP, P-1 beryllium have been made to produce "high ductility" and "high strength" grade materials. The modifications included powder input size, HIP temperature, oxide content, and silicon content. Using optical and electron microscopy, microstructures produced by these modifications were examined to provide an insight into observed mechanical property differences. Results show the mechanical properties were dependent on the grain size as indicated by the Hall–Petch correlation. The grain size was dictated by the powder input size. Other microstructural features are described. (19 figures) (auth)

24601 (UCID–15206) CREEP OF INTERNALLY NITRIDED TZM. Kane, J. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Aug 1967. Contract W-7405-eng-48. 11p. Dep. NTIS $4.00.

Simple, dead load creep measurements were made at 1450°C TZM sheets subjected to nitride dispersion strengthening. Results show that a significant increase in creep strength of Mo can be produced by internal nitridation and testing in nitrogen. (DLC)

24602 (UCID-15598) MECHANICAL BEHAVIOR OF BERYLLIUM AT HIGH PRESSURE. Heard, H. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Mar 1970. 9p. Dep. NTIS $4.00.

The mechanical behavior of pure Be rod has been investigated in triaxial compression at confining pressures ranging to 10 k bars. The test temperature was 25°C, and the strain rate was constant at 2×10^{-5}/s. The pressure coefficient of strength, $d(\sigma_1 - \sigma_3)/d\sigma_3$, averaged 0.14 over the confining pressure range 0 to 10 kbars; the exact value seems independent of strain. Permanent strains were at least 6% in all cases. Young's modulus increased by a factor of three over the pressure range investigated; values ranged from about 0.3×10^6 bars at atmospheric pressure to about 1.0×10^6 bars at 10 kbars. The addition of small fractions of Be to BeO to form cermets for light armor application should materially improve the overall characteristics. (auth)

24603 (UCRL-75610) STUDY OF PLANE STRESS FRACTURE IN THE LARGE-SCALE PLASTIC YIELDING REGIME. Tardiff, G. E.; Kuhn, B. A.; Heldt, L. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Apr 1974. 28p. (CONF-740821-1). Dep. NTIS $4.50.

From 8th national symposium on fracture mechanics; Providence, Rhode Island, USA (26 Aug 1974).

Three independent methods for measuring plane stress fracture resistance in the large-scale plastic yielding regime were tested and were found to give equivalent results. The three methods were the J integral technique, a method based on the increase in compliance that accompanies the development of a plastic zone, and a method based on the direct measurement of the plastic work that must be done to cause fracture. (auth)

24604 (UCID-15632) AUGER ELECTRON SPECTROSCOPY OF BERYLLIUM SURFACES. Fortner, R. J.; Khan, J. M.; Musket, R. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Apr 1970. 7p. Dep. NTIS $4.00.

A study was conducted to determine the surface impurities in three beryllium samples which represented successive phases of a surface preparation treatment. Auger electron spectroscopy (AES) was used to detect the impurities in a few monolayers at the surface. This technique is particularly sensitive for detecting surface impurities. It has a maximum sensitivity of about 0.02 monolayer (1 monolayer = 10^{15} atoms/cm^2). Results of the analysis are shown in graphs in which the derivatives of the secondary electron distribution are plotted as a function of energy. The energies at which the Auger peaks occur are characteristic of the atomic species present. Results of the study show that AES is a useful and sensitive method for detection of impurities within a few atomic layers of the surface. (JRD)

24605 (UCRL-75739) HELIUM RELEASE FROM VARIOUS METALS. Cost, J. R.; Hickman, R. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Jul 1974. 20p. (CONF-741015-1). Dep. NTIS $4.00.

From 21st national symposium of the American Vacuum Society; Anaheim, California, USA (19 Oct 1974).

The metals Al, Fe, Ni, and types 304 and 316 stainless steel were doped with He by allowing dissolved tritium to undergo radioactive decay. He concentrations below 1 atomic ppM were produced. Using high sensitivity, mass spectrometer techniques, He release was observed during isochronal and isothermal anneals. At least two release mechanisms are obvious, their respective gas releases occurring at widely separated temperatures. (auth)

24606 (WAPD-TM-1123) IRRADIATION INDUCED PRIMARY CREEP. Dollins, C. C.; Tucker, R. P. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Apr 1974. Contract AT(36-1)-GEN-14. 23p. Dep. NTIS $4.25.

A model for primary creep of clad materials in an irradiation environment is developed subject to the following assumptions: creep is due to the glide of edge dislocations which encounter irradiation produced depleted zones, as barriers to their motion. The rate controlling step is the climb of the dislocations through the zones. Irradiation affects the creep rate in two opposing ways. The vacancy-rich depleted zones resulting from the irradiation serve as pinning sites for the dislocations thus slowing their glide through the crystal. On the other hand, the radiation-produced interstitials and vacancies cause faster dislocation climb than would be expected out-of-pile. During the early stages of irradiation before the damage due to depleted zones has saturated far more isolated interstitials are produced than isolated vacancies. Consequently, the flux of interstitials to dislocations is substantially greater than that of vacancies causing the dislocations to climb relatively fast. Contributing also to the rapid creep rate in the early stages is the reduced number of obstacles available to pin the dislocations. Once the damage has saturated, it is generally assumed that unassociated vacancies and interstitials are produced in equal numbers; thus, the bias for climb due to an excess of only one type of point defect is substantially reduced. A quantitative model based on these assumptions has been developed and results obtained for zirconium-base alloys. (auth)

24607 (WASH–1186) APPLICATIONS OF FUNDAMENTAL MATERIALS RESEARCH. Ianniello, L. C. (USAEC Division of Research, Washington, D. C.). Aug 1971. 143p. Dep. NTIS $10.25.

A compilation of examples of the paths or histories of specific applications of fundamental materials research is presented. A brief discussion is presented of the overall merit and risk character of the research, to place it in perspective. From this examination of one total program, the Metallurgy and Materials Research program, general conclusions are drawn concerning the application of fundamental materials research results. (auth)

24608 EFFECT OF COLD WORK ON THE STRESS COMPONENTS OF COPPER, V-20Ti-10Nb, AND AUSTENITIC STEEL TYPE 1616 AT ELEVATED TEMPERATURES. Bocek, M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Z. Metallkd.; 65: No. 5, 388-395(May 1974).

12 figs.; 1 tab.; 20 refs.

Cold worked copper, V-20Ti-10Nb and austenitic stainless steel type 1616 were plastically deformed at elevated temperatures. The mean internal stress was measured as a function of deformation. The results obtained in a dynamic tensile test were compared with creep properties. Unlike copper, the plastic properties of the vanadium alloy as well as those of the steel are drastically changed by cold work. The influence of a mechanical treatment on the properties examined can be attributed to the influence of cold work in the effective stress component. In this way the results obtained in both deformation tests are consistent. (GE)

24609 PROPERTIES AND APPLICATIONS OF LOW-ALLOY STEELS FOR ELEVATED TEMPERATURES. Disselmeyer, H. (Thyssen Niederrhein A. G., Oberhausen (F. R. Germany)). Z. Werkstofftech.; 5: No. 4, 177-180(May 1974). (In German).

9 figs.; 1 tab.

The demands on steels for applications at elevated temperatures are discussed. Tensile and toughness data on Mn–Ni–Mo–V steels with ferritic-bainitic structures were studied and dependence on the chemical composition and temperature are given. Influence of pulsating stresses is also reported. (GE)

24610 HYPERFINE MAGNETIC FIELDS AT ^{57}Fe NUCLEI IN SOME COMPOUNDS OF Th. Agarwal, V. K. (Univ. of Udaipur, India). Phys. Status Solidi (a); 23: No. 1, K93-K95(16 May 1974).

Moessbauer spectra of Blow and Van-Diepen et al. for $ThFe_3$ and Th_2Fe_{17} are analyzed on the basis of an empirical relation for hyperfine fields on ^{57}Fe proposed for R_2Fe_{17} compounds. The calculated fields for Th_2Fe_{17} are 343 kOe at 6(c) site, 302 kOe at 18(f), 294 kOe at 9(d), and 266 kOe at 18(h); for $ThFe_3$, they are 204 kOe at 2(c) and 258 kOe at 3(g). If the line intensities (6(c), 18(f), 9(d), 18(h)) are 1:3:1.5:3 for Th_2Fe_{17} and 1:1.5 for 2(c) and 3(g) for $ThFe_3$, the theoretical and experimental spectra agree. The number of Fe nearest neighbors and their interatomic distances determine the fields, with the main contribution coming from inner S electron polarization. (DLC)

24611 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate-Zeitschrift, April 1974. Band 8, No. 4. 185 Referate (Register-Nr. 1191-1599); 90 Referate (Register-Nr. 272T-361T). (Plutonium-Dokumentation, Transplutonium Ele-

ments. Abstract Journal. April 1974. Vol. 8, No. 4, 185 Abstracts (Register No. 1191-1599); 90 Abstracts (Register No. 272T-361T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (Apr 1973). 130p. (In German and English).

Abstracts are given for 498 publications on plutonium and transplutonium elements in the fields of metallurgy, nuclear physics, reactor physics, chemistry, biology, and medicine. (SFL)

24612 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate-Zeitschrift. Mai 1974. Band 8, Heft 5. 168 Referate (Register-Nr. 1600-1900); 83 Referate (Register-Nr. 362T-44T). (Plutonium Documentation. Transplutonium Elements. Abstract Journal. May 1974. Volume 8, No. 5, 168 Abstracts (Register No. 1600-1900); 83 Abstracts (Register No. 362T-444T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (May 1973). 110p. (In German and English).

Abstracts are given for 383 publications on plutonium and transplutonium elements in the fields of metallurgy, nuclear physics, reactor physics, chemistry, biology, and medicine. (SFL)

24613 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate-Zeitschrift. Band 8, Heft 1-3, 1974 1 Vierteljahresregister 1974. (Plutonium-Dokumentation. Abstract Journal with Appendix on Transplutonium Elements. Vol. 8, No. 1-3, 1974. 1st Quarter Index). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1974). 76p. (In German and English).

A cumulative index is presented for the first three bibliographies on plutonium and transplutonium elements published under this project during 1974. (SFL)

24614 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate-Zeitschrift. Juli 1974. Band 8, Heft 7. 151 Referate (Register-Nr. 2288-2582); 52 Referate (Register-Nr. 515T-566T). (Plutonium-Documentation. Transplutonium Elements. Abstract Journal. July 1974. Volume 8, No. 7. 151 Abstracts (Register No. 2288-2582); 52 Abstracts (Register No. 515T-566T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (1974). 104p. (In German and English).

Abstracts are given for 347 publications on plutonium and transplutonium elements in the fields of metallurgy, nuclear physics, reactor physics, chemistry, biology, and medicine. (SFL)

24615 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate-Zeitschrift. Juni 1974. Band 8, Heft 6. 194 Referate (Register-Nr. 1901-2287); 70 referate (Register-Nr. 445T-514T. (Plutonium-Documentation. Transplutonium-Elements. Abstract Journal. June 1974. Volume 8, No. 6. 194 Abstracts (Register No. 1901-2287); 70 Abstracts (Register No. 445T-514T)). Karlsruhe, Ger.; (Jun 1974). 129p. (In German and English).

Abstracts are given for 457 publications on plutonium and transplutonium elements in the fields of metallurgy, nuclear physics, reactor physics, chemistry, biology, and medicine. (SFL)

24616 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate-Zeitschrift. Februar 1974. Band 8, Heft 2. 192 Referate (Register-Nr. 465-809); 92 Referate (Register-Nr. 101T-192T). (Plutonium-Documentation. Transplutonium Elements. Abstract Journal. February 1974. Vol. 8, No. 2. 192 Abstracts (Register No. 465-809); 92 Abstracts (Register No. 101T-192T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (1974). 120p. (In German and English).

Abstracts are given for 437 publications on plutonium and transplutonium elements in the fields of metallurgy, nuclear physics, reactor physics, chemistry, biology, and medicine. (SFL)

24617 MAGNETIC CHARACTERISTICS AND LATTICE CONSTANTS OF SOME PSEUDOBINARY INTERMETALLIC COMPOUNDS OF THE TYPE R_2T_{17}. Deryagin, A.; Ulyanov, A.; Kudrevatykh, N.; Barabanova, E.; Bashkov, Y.; Andreev, A.; Tarasov, E. (Ural State Univ., Sverdlovsk, USSR). Phys. Status Solidi (a); 23: No. 1, K15-K21(16 May 1974).

From international conference on magnetism; Moscow, USSR (22 Aug 1973).

The compounds $(Sm_{1-x}R_x)_2Co_{17}$ (R = Pr, Gd, Y) and $R_2(Co_{1-x}T_x)_{17}$ (R = Sm, Er; T = Fe, Ni) were investigated at room temperature. Lattice constants, Curie point, magnetization, and magnetocrystalline anisotropy were measured. $Sm_2(Co_{0.5}Fe_{0.5})_{17}$ has the greatest magnetic energy (BH_m = 60 MGOe). (DLC)

24618 LOW-STRESS CREEP OF Cd. Crossland, I. G. (Central Electricity Generating Board, Berkeley, Eng.). Phys. Status Solidi (a); 23: No. 1, 231-235(16 May 1974).

High-purity cadmium springs were creep tested between −6 and 36°C at stresses below 5 MN/m^2. Results indicate that the creep mechanism is probably that of grain boundary diffusion creep, but with two modifications: first that subgrain boundaries may act as sources and sinks for vacancies and secondly, that the creep behavior is Bingham rather than Newtonian, i.e., there is a small threshold stress below which no creep occurs. (auth)

24619 DIFFUSION COEFFICIENT AND HEAT OF TRANSPORT OF H AND D IN Nb BELOW ROOM TEMPERATURE. Wipf, H.; Alefeld, G. (Technische Univ., Munich). Phys. Status Solidi (a); 23: No. 1, 175-186(16 May 1974).

The diffusion coefficient and the heat of transport of H and D in Nb were determined by resistance measurements for concentrations between 0.01 and 0.15 at. %. A single activation energy of (0.123 ± 0.006) eV was measured for D in the temperature range 150 to 320°K. For H, a pronounced break in the Arrhenius plot was found at about 225°K in agreement with Gorsky effect measurements. The activation energy changes from (0.093 ± 0.009) eV for T > 225°K to (0.061 ± 0.006) eV for T < 225°K. The ratio of the diffusion coefficients for H and D increases from two at room temperature to about 15 at 150°K. For temperatures between 200 and 320°K, the heat of transport ranges between 0.09 and 0.15 eV for H and between 0.10 and 0.17 eV for D. (33 references) (auth)

24620 DEBYE-WALLER FACTORS OF α-Fe, Ni, Mo, AND W BY LATTICE DYNAMICAL MODELS. Sneh. (Meerut Univ., India). Indian J. Pure Appl. Phys.; 12: No. 2, 89-91(Feb 1974).

The Debye-Waller factors for α-iron, molybdenum, tungsten, and nickel are calculated at different temperatures from the frequency distributions derived from lattice dynamical models. The contribution of the central region of Brillouin zone corresponding to k = 0 has been calculated by replacing the central mesh by a Debye continuum. The results compare reasonably well with the available experimental data obtained from x-ray intensity measurements. (auth)

24621 SIZE DEPENDENCE OF THE MELTING POINT OF SMALL PARTICLES OF INDIUM. Berman, R. P.; Curzon, A. E. (Simon Fraser Univ., Burnaby, B. C.). Can. J. Phys.; 52: No. 11, 923-929(1 Jun 1974).

A Philips E.M. 300 electron microscope operating in the dark field high resolution mode has been used to study the size dependence of the melting points of individual particles of indium. The straight line graph, obtained from a simple thermodynamic treatment of the results, shows that the surface tension at the interface between solid and liquid indium is $\sigma_1 = 101 \pm 10$ dyne/cm. Similar experiments were carried out on tin so that the results of the present experiments could be compared with those of other workers. The value of the interfacial surface tension was $\sigma_1 = 69 \pm 6$ dyne/cm. (auth)

24622 K ABSORPTION EDGE OF ZIRCONIUM IN SOME OF ITS COMPOUNDS. Gupta, M. K. (K. G. Medical Coll., Lucknow, India); Nigam, A. K. J. Phys., F (London); 4: No. 6, 947-950 (Jan 1974).

Using a 1 m radius bent crystal spectrograph, the x ray K absorption edge of zirconium in zirconium metal, zirconium oxide, zirconium tetrachloride and in zirconium oxychloride was studied. In all the compounds investigated, it was observed that the absorption discontinuity shifts towards the high energy side with respect to the pure metal. The shift which is due to the change in the distribution of the valence electrons is a maximum in the case of zirconium nitrate. The relative magnitudes of the shifts in the compounds studied are tentatively explained on the basis of considerations involving electronegativity and interatomic distances. (auth)

24623 MOESSBAUER EFFECT INVESTIGATION OF Y-Fe COMPOUNDS. Gubbens, P. C. M. (Interuniversitair Reactor Instituut, Delft, Netherlands); van Apeldoorn, J. H. F.; van der Kraan, A. M.; Buschow, K. H. J. J. Phys., F (London); 4: No. 6, 921-927(Jun 1974).

Mössbauer spectra were taken of the compounds YFe_2, YFe_3, Y_6Fe_{23} and Y_2Fe_{17} at temperatures ranging from 15°K to well above the Curie temperatures (T_c = 540, 538, 496 and 358°K, respectively). The various spectra were analyzed by means of subspectra due to the different nonequivalent Fe sites occurring in these compounds. For each of these sites the temperature dependence of the hyperfine field was determined and shown to be similar for different sites within the same compound. (auth)

24624 CESIUM-OXYGEN COADSORPTION WITH W(100). Desplat, J. L. (CEN de Saclay, Gif-sur-Yvette, France). Vide; 28: No. 167, 184-186(Sep 1973). (In French).

The work-function change of a (100) tungsten single crystal was studied with cesium or oxygen adsorption and cesium-oxygen coadsorption, at room temperature. The surface cleanliness and the relative coverages were monitored by Auger electron spectroscopy (AES). A linear relationship was obtained between the oxygen Auger peak height and the coverage. AES of adsorbed cesium reveals some new features: a triplet near 48 eV, a 62 eV peak associated with $N_{4,5}O_{2,3}V$ transitions. For coadsorbed cesium and oxygen, small shifts are observed on Cs peaks and a new 56.5 eV peak appeared which can be reasonably explained by a coupling between cesium levels and oxygen valence band. Estimation of the change in the backscattering factor for Cs Auger electrons, due to the

underlying oxygen layer, is made and shows that the increase with the oxygen coverage of the Auger signal of Cs at saturation is mainly due to an effective increase of the adsorbed Cs amount, consistently with the observed growth in the work-function. (FR)

24625 EFFECT OF ANNEALING ON STRUCTURE AND PROPERTIES OF A DISPERSION STRENGTHENED SUPERALLOY, IN-853. Cairns, R. L. (International Nickel Co., Inc., Suffern, NY). Met. Trans.; 5: No. 7, 1677-1684(Jul 1974).

Dispersion strengthened nickel-base superalloy bar was produced by hot extrusion of mechanically alloyed powders. The fabrication methods produce an ultra-fine grained material which resists grain growth up to a critical temperature around 1506°K (2250°F). Above this temperature, a discontinuous grain growth process leads to the formation of coarse elongated macrograins. The material becomes completely coarse grained in short times. Annealing below this temperature produces only slight grain coarsening, and relieves stored strain energy. Changes in properties are related to the grain growth and strain annealing processes. (4 tables, 11 figures) (auth)

24626 TEMPERATURE-DEPENDENT SPIN-DISORDER RESISTIVITY IN A VAN VLECK PARAMAGNET. Andersen, N.H.; Gregers-Hansen, P.E.; Holm, E.; Smith, H. (Physics Laboratory I, H. C. Ørsted Institute, University of Copenhagen, Copenhagen, Denmark); Vogt, O. Phys. Rev. Lett. 32: No. 23, 1321-1324 (10 June 1974).

We have measured the resistivity of single-crystal paramagnetic $Tb_xY_{1-x}Sb$ with x=0, 0.05, 0.20, 0.40. At low temperatures a resistance anomaly develops in proportion to x. The observed resistance anomaly reflects the temperature-dependent probability that the conduction electrons are scattered from the crystal-field-split 4f levels of the Tb ions by elastic as well as inelastic processes. A calculation of this anomaly yields excellent agreement for those values of x for which indirect exchange can be neglected. (auth)

24627 PRECIPITATION, HARDENING AND CREEP STRENGTH OF VANADIUM ALLOYS. Erdmann-Jesnitzer, F.; Wichmann, H. J. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Werkstoffkunde B). Metall; 28: No. 2, 113-116(Feb 1974). (In German).

7 figs.; 10 refs.

Within the framework of the research work for the development of fast breeder reactors, new structural materials had to be found and tested. Looking for suitable base materials to be used as fuel element cladding material, vanadium has been found to meet the given criteria. In order to improve the creep strength of vanadium base alloys, experiments have been made to achieve dispersion by reaction products formed in the molten material. These experiments have shown that zirconium is a suitable alloying element, mainly for thermodynamical reasons. The amount of zirconium to be added has to be well adjusted to nitrogen and/or oxygen content of the alloy as the binding of interstitial impurities decisively determines the mechanical properties of vanadium alloys, especially with regard to the required creep strength. (GE)

24628 UTILIZATION OF FOIL RESISTANCE STRAIN GAGES TO MEASURE THE THERMAL EXPANSION ANISOTROPY OF SEVERAL TYPES OF BERYLLIUM. Kinan, A. M. (Rockwell International, Anaheim, CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 17, 37-44(1974).

From international symposium on thermal expansion of solids; Lake of the Ozarks, Missouri, USA (7 Nov 1973). See CONF-731118-.

Values of thermal expansion anisotropy are presented for various types of beryllium, including hot pressed, hot isopressed, cold isopressed, and extruded beryllium. The results were obtained by means of foil resistance strain gages. The data were collected in the temperature range of 75 to 200°F. A method devised to characterize the thermal expansion of a piece of single crystal silicon is described. This piece of silicon has been used to verify the manufacturer's values of thermal expansion compensation for the strain gages. (auth)

24629 ANOMALOUS BEHAVIOR OF THERMAL EXPANSION OF SOME Cr-BASE SOLID SOLUTION ALLOYS, AND NON-FERROMAGNETIC INVAR ALLOYS. Fukamichi, K.; Saito, H. (Tohoku Univ., Sendai). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 17, 45-55(1974).

From international symposium on thermal expansion of solids; Lake of the Ozarks, Missouri, USA (7 Nov 1973). See CONF-731118-.

Invar and Elinvar alloys are widely applied for precision measurement instruments. These practical alloys are all ferromagnetic, and the ferromagnetism of these alloys often limits the scope of their application. In recent years, therefore, a considerable amount of efforts are devoted to the research and development for nonferromagnetic Invar or Elinvar alloys. Cr is an antiferromagnetic metal and its magnetic properties can be explained by the spin density wave (SDW) theory. The physical properties such as thermal expansivity and electrical resistivity change anomalously near the Néel temperature, and these properties are sensibly modified by the addition of other elements. Taking these data into consideration, the temperature dependences of the physical properties for some Cr-base primary solid solution alloys were investigated. These alloys were found to have a certain temperature region in which both Invar and Elinvar characteristics coexist. It is the first time that both characteristics have been found in the same alloys. The alloys are practically free from the effect of any magnetic field. (auth)

24630 TEMPERATURE DEPENDENT PECULIARITIES OF MAGNETIC PROPERTIES OF $SmCo_5$ SINGLE CRYSTALS. Deryagin, A.; Ulyanov, A. (Ural State Univ., Sverdlovsk, USSR). Phys. Status Solidi (a); 24: No. 1, K11-K13(16 Jul 1974).

The magnetic properties were measured at 77 to 300°K after magnetization in a 28-kOe field. All the monocrystals had a rectangular hysteresis loop, and their remagnetization occurred in a jump in the intrinsic field H_{oi}. The residual remanence induction and saturation induction were equal (11 kG) and the maximum energy product reached 30×10^6 GOe. The temperature dependence of H_{oi} is shown to vary for different monocrystals. (auth)

24631 TEMPERATURE DEPENDENCE OF THE IMPURITY ELECTRIC QUADRUPOLE INTERACTION: CADMIUM AND TANTALUM IN TITANIUM. Kaufmann, E. N. (Bell Telephone Labs., Murray Hill, NJ); Raghavan, P.; Raghavan, R. S.; Krien, K.; Naumann, R. A. Phys. Status Solidi (b); 63: No. 2, 719-726 (1 Jun 1974).

The electric quadrupole interaction at Cd and Ta impurity nuclei implanted in trace amounts in a titanium host lattice has been measured as a function of temperature by means of the time-differential perturbed angular correlation technique. The results show a striking difference in the temperature dependences for the two impurity species. This implies that, in addition to the previously observed temperature dependence arising from lattice expansion and conduction electron redistribution of the host, there exist significant local temperature dependent effects associated with the specific characteristics of the impurity. (auth)

24632 HARTREE ENERGY OF SIMPLE METALS. Mahan, G. D. (Indiana Univ., Bloomington). Phys. Status Solidi (b); 63: No. 2, 453-457(1 Jun 1974).

The Hartree energy is the energy eigenvalue of an electron in the potential field of an ion and the other electrons. This eigenvalue is computed numerically for seventeen metals. For divalent and monovalent metals, the eigenvalue is very small, of the order of a few hundredths of a Rydberg. (auth)

24633 ATOMISTIC FORMULATION FOR THE MELTING POINT OF METALLIC ELEMENTS. Plendl, J. N. (Air Force Cambridge Research Labs., Bedford, MA). Phys. Status Solidi (b); 63: No. 2, 519-527(1 Jun 1974).

The formulation for the melting point of metallic elements, derived from relations recently deduced from an analysis of the infrared spectra of solids, involves three atomic characteristics which decisively determine the melting point. They are: the critical amplitude of the thermal vibrations, the atomic coordination valency, and a structural parameter, the reciprocal of which is proportional to the atomic packing density. The higher the bond strength of the atoms within the atomic coordination in the lattice (atomic coordination valency) and the lower the collision frequency of the vibrating atoms (proportional to the atomic packing density and to the eigen frequencies), the higher a temperature is required to produce the critical amplitude of the atomic vibrations, which eventually causes the breakdown of the lattice bonds, and so starts the melting process. The formulation has been verified by the agreement obtained between experimental and calculated data of 20 metallic elements with strong bondings. In relating the critical amplitude of the atomic vibrations with the data of full-range thermal expansion up to the melting point, an atomistic explanation of the phenomenon of thermal expansion has been developed, without recourse to asymmetrical vibrations, nonexistent in metallic elements with cubic structures. (auth)

24634 RELAXATION PROCESS IN U^{3+}:$LaCl_3$ DETECTED BY RESONANT SELF-ABSORPTION OF FLUORESCENCE. Furrer, R.; Seiff, F.; Pelzl, J. (Freie Univ., Berlin). Phys. Status Solidi (b); 63: No. 2, 549-553(1 Jun 1974).

Using a pulse saturation method with optical detection of the recovery of fluorescent light, the temperature dependence and angular anisotropy of the spin-lattice relaxation rate T_1^{-1} of U^{3+} in anhydrous lanthanum trichloride has been measured. In the

range 1.5°K ≤ T ≤ 4.2°K the direct relaxation process was found to be dominant, leading to a relaxation rate which can be fitted to the expression $T_{1d}^{-1} = 4.16(5)T\ s^{-1}$ with the anisotropy coefficient of the direct process A ($\theta = 90°$)/A ($\theta = 0°$) ≈ 10. Both results are comparable with the data measured for the corresponding $4f^3$ ion, Nd^{3+} in $LaCl_3$. (auth)

24635 EXCITATION SPECTRUM OF A RARE-EARTH ALLOY. Tucker, J. W. (Sheffield Univ., Eng.). Phys. Status Solidi (b); 63: No. 2, 563-567(1 Jun 1974).

The dispersion relation for the coupled nuclear and electronic spin wave modes that exist in magnetically ordered materials due to the hyperfine interaction is derived for arbitrary concentrations of nuclear spins. The calculation makes use of a diagrammatic technique in which the evaluation of the thermal averages of products of spin operators is facilitated by the use of the drone-fermion representation. Criteria are established for the validity of the proposal by Jones [J. Phys. C6, L371 (1973)] that the results of molecular field theory hold for arbitrary concentrations. (auth)

24636 SECONDARY SCATTERING IN COMPTON PROFILE MEASUREMENTS. McIntire, W. R. (Cornell Univ., Ithaca, NY). Phys. Status Solidi (a); 23: No. 2, 359-366(16 Jun 1974).

Calculations of secondary Compton scattering spectra are presented for 60 keV photons scattered at 180°. The presence of secondary scattering modifies measured spectra in such a way that apparent high-momentum tails are added to the valence profiles, and the heights of the normalized profile of Be has been measured using 60 keV photons and a small sample from which secondary scattering is negligible. Comparison of the results with those of x-ray diffractometer measurements points out secondary scattering effects present in the latter. The valence profiles have high-momentum tails, and the profiles are asymmetric with higher values on the low-energy side of the profiles. These effects are probably present in many reported profiles of low atomic number samples. (auth)

24637 GROWTH OF TIPS IN THE DIRECTIONS NORMAL TO CLOSE-PACKED FACES BY HEATING IN THE PRESENCE OF AN ELECTRIC FIELD. Shrednik, V. N.; Pavlov, V. G.; Rabinovich, A. A.; Shaikhin, B. M. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Status Solidi (a); 23: No. 2, 373-381 (16 Jun 1974).

The behavior of tungsten tips heated in the presence of a high electric field is investigated by means of the field emission microscope. The latter operated both as a field electron and field ion microscope. At T > 2000°K and F > 3×10^7 V/cm growth of {110} type faces in the direction of surface normals was observed. It manifested itself as outgrowths on these faces, the dimensions of which were comparable to the tip radius. The large size of the central {110}-face, a large curvature in the ⟨110⟩ crystallographic zone region, and a terrace—or ledgeform—were typical features of the macroscopical outgrowths on the {110}-plane. The macroscopical outgrowths take the annealing form after heating without field or the field evaporation endform after cold field evaporation. (auth)

24638 EFFECT OF A TRANSVERSE DRIFT VELOCITY OF THE ELECTRONS ON HELICON WAVES IN InSb. Pic, E.; Ligeon, M. (Laboratoire d'Electromagnetisme, Grenoble, France). Phys. Status Solidi (a); 23: No. 2, 409-416(16 Jun 1974).

Helicon waves are excited from an evanescent microwave at 1 to 2 GHz above an InSb rod subjected to crossed static electric and magnetic fields. The recorded variations of microwave power against static magnetic field B, sample temperature, and sample current are explained by invoking the existence of "modified" helicon waves. From theoretical calculations, the electronic drift velocity involves a longitudinal component of the microwave electric field. This one is proportional to the drift velocity, the phase velocity of the helicon wave remaining unaffected. This model is able to explain the measurements. The main parameters of the semiconductor (mobility, carrier concentration, and drift velocity) are deduced from the experimental results. (auth)

24639 VARIATION OF PERIOD WITH VALENCE ELECTRON CONCENTRATION IN RT_y ONE-DIMENSIONAL LONG-PERIOD SUPERSTRUCTURES. Khan, Y. (Ruhr-Univ., Bochum). Phys. Status Solidi (a); 23: No. 2, 425-434(16 Jun 1974).

The crystal structures of the RT_y (R = Y, Th, or Pu, T = Fe, Co, or Ni, $2 \leq y < 5$) intermetallic compounds, where $y = (5n + 4)/(n + 2)$, n = 0, 1, 2, 3, ..., are one-dimensional long-period superstructures of the $CaCu_5$-type structure, with period, P, given by $P = 2(n + 1)$. The period of these superstructures is related with the valence electron concentration, i.e. number of valence electrons per atom, e/a, as follows: $e/a = 1/2 + 1/P$. Since the value of e/a, according to this equation, becomes nearly constant for P value greater than eight, RT_y one-dimensional long-period superstructures having periods greater than this value are not likely to exist distinctly. Variation of lattice parameters with composition of RT_y supports this conclusion, too. The equilibrium phase diagram of the Y–Co system is presented. (auth)

24640 STUDY OF THE SCATTERING-PROCESSES AND TRANSPORT PHENOMENA UNDER PRESSURE OF THE PSEUDO-BINARY COMPOUND $Ga_xIn_{1-x}Sb$. Averous, M.; Calas, J.; Fau, C.; Joullie, A. (CNRS, Montpellier, France). Phys. Status Solidi (a); 23: No. 2, 495-506(16 Jun 1974).

An investigation is made of the scattering processes in the pseudo-binary compound $Ga_xIn_{1-x}Sb$ for values of x between 0 and 0.33. It is shown that when x is low, the interaction between the bands s and p must be taken into account. The measurement of the mobility when an isotropic strain is applied, with its logarithmic differential, gives direct data about the scattering processes being at work. (auth)

24641 TOTAL ENERGY DISTRIBUTION OF FIELD EMITTED ELECTRONS FROM A Mo MONOCRYSTAL COVERED WITH Al_2O_3 AND SiO_2 BY MEANS OF A FIELD EMISSION MICROSCOPE. Bobev, K.; Gaidarova, V. (Central Lab. of Agrophysics Research, Sofia). Phys. Status Solidi (a); 23: No. 2, K129-K133(16 Jun 1974).

The measurements were made on the (111) face of a Mo crystal covered by 1 to 8 monolayers of the oxides. It was found that the effects of electric fields on total energy distribution of field emitted electrons is proportional to the difference in the change of the field in the region of excited levels. The two oxide coatings have a wide forbidden band, and a square dependence on the electric field might be expected. (JRD)

24642 ANTIFERROMAGNETISM IN UGa_3. Murasik, A. (Inst. of Nuclear Research, Warsaw); Leciejewicz, J.; Ligenza, S.; Zygmunt, A. Phys. Status Solidi (a); 23: No. 2, K147-K149 (16 Jun 1974).

Polycrystalline samples of UGa_3 were examined by neutron diffraction. An observed low value of the U magnetic moment is due to the strong 6d–7s hybridization which suppresses the magnetic moment in the ordered state. Paramagnetism was found to occur at temperatures down to 4.2°K. (JRD)

24643 EFFECT OF CRYSTAL DEFECTS ON THE MAGNETOCRYSTALLINE ANISOTROPY OF THE R–Co PERMANENT MAGNET MATERIALS. Khan, Y. (Ruhr-Univ., Bochum, Ger.). Phys. Status Solidi (a); 23: No. 2, K151-K158(16 Jun 1974).

The magnetocrystalline anisotropy field was measured on polycrystalline powder samples practically free of texture using a pulsed high-field magnetometer. It was found that regions may occur in rare earth–Co (RCo) phases incorporating large numbers of crystal defects along with phases having small numbers of defects. The regions having large numbers of crystal defects should have low magnetocrystalline anisotropy, and hence serve as centers of easy domain wall nucleation, thus, deteriorating the permanent magnet properties of these materials. (JRD)

24644 MAGNETIC STRUCTURE OF UCu_5. Murasik, A.; Ligenza, S.; Zygmunt, A. (Inst. of Nuclear Research, Warsaw). Phys. Status Solidi (a); 23: No. 2, K163-K165(16 Jun 1974).

A neutron diffraction study was conducted to verify that magnetic ordering occurs in UCu_5, to determine the corresponding magnetic structure, and to determine the magnetic moment of μ ions in the ordered state. The lack of M(111) magnetic peak reflection in the parallel magnetic lattice sheets is the basis for concluding that the magnetic moments are perpendicular to the ferromagnetic sheets. The magnetic moment at 4.2°K estimated from M(311) peak was $(0.9 \pm 0.1)\mu_B$ (magnetic flux density). (JRD)

24645 TRANSFORMATION TEMPERATURES AND MAGNETIC PROPERTIES OF THE ORDERED HEXAGONAL VCo_3 COMPOUND. Aoki, Y.; Asami, K.; Yamamoto, M. (Tohoku Univ., Sendai). Phys. Status Solidi (a); 23: No. 2, K167-ZK169 (16 Jun 1974).

The lattice parameter of the VCo_3-type structure was estimated from the (40.4) and (00.12) reflection lines. Magnetic measurements were made at magnetic fields up to 10.55 kOe and at temperatures from 4.2 to 295°K. Thermomagnetic curves for the ferromagnetic alloys containing 22.0 and 22.8 at. %V were measured using an automatic recording magnetometer. The existence of a Curie constant (C) for the Co-rich alloys may be attributed to the magnetic excess Co atoms (on V atomic sites) in contrast to the non-magnetic normal Co atoms (on Co atomic sites), because of the difference of their local atomic environments. The magnetic moments per excess Co atom for the 24.2 and 24.9 at. %V alloys calculated from C are 5.9 and 3.8 μ_B (magnetic induction), respectively. These large values compared with pure Co moment of 1.72 μ_B reveal the polarization of the neighboring normal Co atoms. (auth)

24646 PERMANENT MAGNETIC PROPERTIES OF MONOCRYSTALLINE $SmCo_5$. Deryagin, A.; Ulyanov, A.; Barabanova, E.; Bashkov, Y. (Ural State Univ., Sverdlovsk, USSR). Phys. Status Solidi (a); 23: No. 2, K199-K202(16 Jun 1974).

Monocrystals of $SmCo_5$ in form of spheres with diameter 2 to 3 mm were investigated. From the measurements of the crystal lattice parameters it follows that they generally were enriched in cobalt with respect to stoichiometric $SmCo_5$. The samples were annealed at various temperatures in an atmosphere of pure helium during 30 min followed by quick cooling. All magnetic properties of monocrystals were measured in a vibrating-sample magnetometer. It was found that the non-monotonous dependence of the coercive force (the nucleation field) on annealing temperature is observed not only for $SmCo_5$ powder samples, it also takes place for individual monocrystals (particles). The reasons of such a dependence suggested for monocrystals are apparently valid for powders, too. The same results may be expected for other compounds of RCo_5 type. (auth)

24647 MAGNETIC PROPERTIES OF A $TmCo_2$ SINGLE CRYSTAL. Deportes, J.; Gignoux, D.; Givord, F. (CNRS, Grenoble, France). Phys. Status Solidi (b); 64: No. 1, 29-32(1 Jul 1974).

The magnetization of a spherical single crystal of the ferrimagnetic $TmCo_2$ compound was studied in fields up to 140 kOe. Below the ordering temperature ($4°K \leq T_c \leq 7°K$ depending on the melting method) the easy magnetization axis is [111]. Using the fact that the difference in the anisotropy energy between the [111] and [110] axis is very small, the relative importance of fourth and sixth order terms of the crystalline potential was estimated. The existence of a singlet ground state explains the low spontaneous magnetization observed at 1.5°K. (auth)

24648 INFLUENCE OF PLASMONS ON X-RAY EMISSION BANDS OF SOME SIMPLE METALS. Pimpale, A.; Mande, C. (Nagpur Univ., India). Phys. Status Solidi (b); 64: No. 1, 387-394 (1 Jul 1974).

The appearance of plasmon satellites in the x-ray emission spectra should give rise to a reduction in free electron conduction band widths according to the intensity conservation rule. A simple method is suggested to study this reduction by modifying the Sommerfeld formula for the phase space available to the single-particle excitations and the effective electronic mass due to the existence of the plasmons. It is found that the calculated band widths agree fairly well with corresponding experimental values for some simple metals (Li, Be, Na, Mg, Al, K). The inclusion of the exchange and correlations, however, removes the agreement between the theoretical and experimental values of the band width. This is attributed to the fact that the long- and short-wavelength tails are avoided in experimental measurements, whereas their effects are included in the exchange and correlation corrections. (auth)

24649 MAGNETIC PROPERTIES OF NpPt AND PuPt. Smith, J. L.; Hill, H. H. (Los Alamos Scientific Lab., NM). Phys. Status Solidi (b); 64: No. 1, 343-350(1 Jul 1974).

NpPt was found to be antiferromagnetic below 27°K, PuPt ferromagnetic (or perhaps ferrimagnetic) below 19°K and antiferromagnetic between 19 and 44°K. The apparent ferromagnetic saturation moment of PuPt is $\approx 0.22\ \mu_B$ per Pu atom. The transition from antiferromagnetism to ferromagnetism in PuPt is moderately sensitive to applied field, the overall cooperative magnetic behavior of the compound being qualitatively similar to that of the heavy rare earth metals. (7 figures) (auth)

24650 DISPLACEMENT FIELD OF A DISLOCATION LOOP IN ANISOTROPIC CUBIC CRYSTALS. Ohr, S. M. (Oak Ridge National Lab., TN). Phys. Status Solidi (b); 64: No. 1, 317-323(1 Jul 1974).

The displacement field around a dislocation loop in anisotropic cubic crystals was calculated on the basis of the continuum theory. The components of displacement were obtained by means of the Fourier inversion formula applied to the product of Fourier transforms of the elastic Green's function and the body force density appropriate for a circular dislocation loop. In performing the inverse transformation, the radial part of the integration was carried out analytically while the double integral over solid angle was evaluated numerically. Results for dislocation loops in Cu and Nb are presented in the form of equi-displacement contour plots. In general, the displacement field is proportional to the anisotropy factor $A = 2c_{44}/(c_{11}-c_{12})$. In Cu, the magnitude of the displacement fuel is greater than that of an elastically isotropic crystal by a factor of as much as two. (auth)

24651 CYCLOTRON RESONANCE INVESTIGATIONS OF NIOBIUM. Preppernau, U.; Herrmann, R.; Rothkirch, L.; Dwelk, H. (Humboldt Univ., Berlin). Phys. Status Solidi (b); 64: No. 1, 183-194(1 Jul 1974).

Cyclotron resonance (CR) and EPR measurements of niobium single crystals are presented. At Nb— in distinction to other metals— CR signals are detectable only by certain additional requirements, as time of precooling or speed of magnetic field sweep. The results are interpreted on the basis of the Mattheiss model. Some pecularities of the spectrum are explained by a magnetic breakdown. (auth)

24652 STATIC LATTICE GREEN'S FUNCTION AND ITS ASYMPTOTIC BEHAVIOR FOR FCC AND BCC CRYSTALS. Schober, H. R. (Kernforschungsanlage, Juelich, Ger.); Mostoller, M.; Dederichs, P. H. Phys. Status Solidi (b); 64: No. 1, 173-182 (1 Jul 1974).

The static lattice and elastic Green's functions (GF) are compared for Born–von Karman models of Cu, Al, Nb, and Li. If the spectrum for lower frequencies is determined by small q-values only, the lattice GF agrees quite well with its elastic counterpart outside the effective range of the coupling parameters. This result is in contrast to earlier calculations which did not treat the Fourier integration near q = 0 accurately enough. (auth)

24653 MUFFIN-TIN IMPURITY MODEL AND ITS APPLICATION TO 3d TRANSITION METAL IMPURITIES IN ALUMINUM. Mrosan, E. (Zentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden); Lehmann, G.; Woittennek, H. Phys. Status Solidi (b); 64: No. 1, 131-138(1 Jul 1974).

A muffin-tin impurity model for the scattering properties of substitutional impurities is applied to 3d transition metal impurities in Al. The relative potential between impurity muffin-tin and host muffin-tins is chosen in such a way that a sum rule for the scattering phase shifts is fulfilled to obtain selfconsistent screening of the impurity charge. Calculations of the change in the electronic density of states and residual resistivity are presented, which show a characteristic behavior due to the fact that a virtual bound state is crossing the Fermi level of the host. (6 figures) (auth)

24654 ELECTRON MOMENTUM DISTRIBUTION IN VANADIUM AND VANADIUM HYDRIDE. McIntire, W. R.; Batterman, B. W. (Cornell Univ., Ithaca, NY). Phys. Status Solidi (b); 63: No. 2, 621-624(1 Jun 1974).

The Compton profiles of vanadium and vanadium hydride have been measured. The two profiles are in agreement for values of the electron momentum greater than 1.5 at. units, indicating that the vanadium core electron momentum distribution is unchanged by addition of the hydrogen. The difference between the profiles is in the valence electron region, and it supports the model of the hydrogen atom giving its electron to the vanadium Fermi sea. (auth)

24655 WHITE LINE AT THE L_{III} AND L_{II} EDGES OF Sm IN METAL AND ITS COMPOUNDS. Kushwaha, M. S.; Shrivastava, B. D.; Dubey, V. S. (Vikram Univ., Ujjain, India). Phys. Status Solidi (b); 64: No. 1, 65-69(1 Jul 1974).

The L-absorption spectra of Sm in the metal and some of its compounds were recorded photographically using a 40-cm bent crystal x-ray spectrograph, kept inside a vacuum chamber. The white lines were observed at the L_{III} and L_{II} edges of Sm in the metal and its compounds and their occurrence are attributed to the transition from 2p states to the vacant part of 5d bands. The values of the various parameters, used to define the position and size of the white line, are presented. An empirical relation between these parameters was established. The effective slit width of the spectrograph was found to be about 10 eV from this relation. (auth)

24656 CRYSTAL FIELDS IN ErCu, ErAg, AND ErZn. Morin, P. (Centre National de la Recherche Scientifique, Grenoble, France); Pierre, J.; Rossat-Mignod, J.; Knorr, K.; Drexel, W. Phys. Rev., B; 9: No. 11, 4932-4938(1 Jun 1974).

The splitting of the crystal-field levels in the intermetallic compounds ErM (M = Ag, Cu, Zn) has been determined by inelastic neutron scattering experiments. In all three cases, the crystal-field parameters $A_4^0\langle r^4\rangle$ and $A_6^0\langle r^6\rangle$ are negative and of the same order of magnitude. The ground state is always a $\Gamma_5^{(2)}$ quadruplet. The point-charge model fails to explain the large values of the sixth-order terms. The crystal-field Hamiltonian is used to interpret the magnetic properties of these compounds. (auth)

24657 NICKEL BASE ALLOY CONTAINING HAFNIUM. Dalal, R. P.; Walters, J. J.; Ewing, B. A. (to Avco Corp.). US Patent 3,807,993. 30 Apr 1974. Filed date 12 Apr 1972. 6p.

The Ni-base, Co-containing alloys contain relatively small, but nonetheless significant, amounts of W and Mo for solid solution strengthening, Cr for oxidation and sulfidation resistance, Ta for solid solution and carbide strengthening, Al and Ti to enhance the strength by precipitation of a fine dispersed phase, gamma prime $Ni_3(Al,Ti)$ and Hf for intermediate strength, ductility, and improved oxidation resistance. (auth)

24658 SURFACE STRUCTURE DEFECTS IN TUNGSTEN CRYSTALS DUE TO DIFFUSION OF PLATINUM. Vasil'kovskii, D.N.; Zotova, O.B. Sov. Phys.-Solid State 16: No. 1, 201-202 (July 1974).

An electron microscope has been used to study the structure defects in the surface layer of tungsten crystals due to anomalous diffusion of platinum. (AIP)

24659 THE STRUCTURE AND ADHESION OF COATINGS DEPOSITED BY WIRE EXPLOSION SPRAYING. Suhara, T.; Kitajima, K.; Fukuda, S. (Research Institute for Applied Mechanics, Kyushu University, Fukuoka, Japan); Ito, H.; Fukunaga, H. J. Vac. Sci. Technol. 11: No. 4, 787-792 (July 1974).

The coating method and the characteristics of wire explosion spraying, as developed in our laboratory, are described. A study of the mechanism of adhesion between the coating and substrate in two metal systems, W–mild steel and W–Cu which differ in mutual solubility, is discussed. Metallographic observations using electron probe and soft x ray confirmed the presence of a solid solution boundary layer in the case of the mild steel substrate, with a critical shearing stress of adhesion measured by our method ranging from 20 to 26 kg/mm^2, which is nearly equal to the shearing strength of the tungsten coating itself of 24 kg/mm^2; fracture propagated within the coating itself. In the case of the copper substrate the critical shearing stress of adhesion was from 9 to 13 kg/mm^2 which is much weaker than the shearing strength of copper, 28 kg/mm^2; the fracture propagated along the boundary between the coating and substrate. Theoretical considerations attempt to explain the mechanisms of formation of the structures and the adhesion properties. It is concluded that the high adhesion strengths obtained by this method are attributable to the characteristics of the particles sprayed by wire explosion, i.e., the small size (average 5 μ), the high temperature (near the boiling point of materials), the high impinging velocity (500–600 m/sec), and furthermore, the uniformity of the size, velocity and temperature of the sprayed particles. (auth)

24660 OPTICAL PROPERTIES OF V, Ta, AND Mo FROM 0.1 TO 35 eV. Weaver, J.H.; Lynch, D.W.; Olson, C.G. (Ames Laboratory, United States Atomic Energy Commission and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. B 10: No. 2, 501-516 (15 July 1974).

The absorptivity or reflectivity of crystals of V, Ta, and Mo was measured from 0.1 to 35 eV. The data were Kramers–Kronig analyzed to determine the dielectric functions. The inadequacy of a simple Drude model to describe absorption at low energy is discussed. Structure in the dielectric functions is discussed in terms of direct interband transitions which extend to about 18 eV. Features below 6 eV are attributed to transitions near Σ, G, and perhaps along P(D)N for V, Ta, and Mo, with additional transitions in Mo from the Δ portion of the Brillouin zone. High-lying energy bands are identified as giving rise to high-energy structure in the dielectric functions. Results obtained previously for Nb are reviewed and compared. The electron-energy-loss functions were calculated and are discussed in terms of volume and surface plasmons. These metals all exhibit two volume and two surface plasmons. (auth)

24661 SOFT x-RAY APPEARANCE POTENTIAL SPECTROSCOPY OF LANTHANUM, GADOLINIUM, AND THORIUM. Murthy, M.S.; Redhead, P.A. (Division of Physics, National Research Council, Ottawa, Canada K1A OR6). J. Vac. Sci. Technol. 11: No. 4, 837-842 (July 1974).

The electron binding energies of La (M_2–$N_{5,4}$ levels), Gd (M_5–$N_{5,4}$ levels) and Th (O_5–N_1 levels) were determined by SXAPS and compared with those obtained by ESCA and by calculation. The results are in reasonable agreement. The La was oxidized and the shift in the SXAPS peaks was less than 1 eV. Satellite peaks have been observed associated with the M_5, M_4, and $N_{5,4}$ peaks of La and Gd and the O_5 and O_4 peaks of Th. Possible mechanisms responsible for these satellite peaks are discussed. (auth)

24662 HIGH-TEMPERATURE STRENGTH STABILITY OF THREE FORMS OF CHEMICALLY VAPOR DEPOSITED TUNGSTEN. Bryant, W.A. (Westinghouse Astronuclear Laboratory, Pittsburgh, Pennsylvania 15236). J. Vac. Sci. Technol. 11: No. 4, 695-699 (July 1974).

Three types of CVD tungsten (fluoride-produced, chloride-produced, and a layered composite of the two-termed duplex) were evaluated to determine their high-temperature strength and microstructural stability following 5000-h exposure to temperatures of 1540 and 1700°C. At the highest temperatures investigated (1540 and 1700°C) the tensile strengths of the two basic materials were essentially equal. At lower temperatures, chloride tungsten possessed lower yield strength but higher ultimate strength than fluoride tungsten while the behavior of the duplex material was generally intermediate. Apparent anomalies in high-temperature elongation behavior are explained on the basis of grain boundary cavity formation and recrystallization. The grain size of fluoride tungsten changed only slightly following 5000-h treatment at 1700°C. In contrast, chloride tungsten possessed both poor resistance to grain growth and an accompanying relatively high ductile-brittle transition temperature. (auth)

24663 FACTORS AFFECTING THE ADHERENCE OF CHEMICALLY VAPOR-DEPOSITED COATINGS. Bryant, W.A. (Westinghouse Astronuclear Laboratory, Pittsburgh, Pennsylvania 15236); Meier, G.H. J. Vac. Sci. Technol. 11: No. 4, 719-724 (July 1974).

The causes of nonadherence of chemically vapor-deposited coatings are considered. The absence of substrate attack by the gases present in the system is shown to be a necessary criterion, in addition to those usually cited, for coating adherence. The importance of this criterion is illustrated for a number of coating experiments from the literature. The use of standard free-energy data for predicting substrate attack is also illustrated. Cases in which standard free-energy data alone are not sufficient are also considered and illustrated for the adherence of tungsten coatings on tantalum substrates. (auth)

24664 EFFECTS OF DEPOSITION PARAMETERS ON PROPERTIES OF RF SPUTTERED MOLYBDENUM FILMS. Nowicki, R.S.; Buckley, W.D. (Energy Conversion Devices, Inc., Troy, Michigan 48084); Mackintosh, W.D.; Mitchell, I.V. J. Vac. Sci. Technol. 11: No. 4, 675-679 (July 1974).

We report a preliminary survey of the effects of dc substrate bias and residual gas contamination on the average composition, internal stress, electrical conductivity, and crystal structure of molybdenum films deposited by rf sputtering. We find strong interrelations among all these parameters. Thus films sputtered in residual pressure approximately 10^{-5} Torr exhibit stress changing from tensile to compressive with increasingly negative bias, passing through neutrality at about −15 V. Quantitative analysis, however, reveals that stress relief is attained only at the expense of the incorporation of large (30 at.%) amounts of oxygen and nitrogen. This in turn substantiates the attribution of the fcc structure observed in such films to a MoN_x phase rather than a new polytype of Mo. Deposition at lower residual pressure with floating bias results in bcc structure, negligible gas incorporation, closer approach to bulk conductivity, but compressive stress. These results suggest the necessity for compromise in the choice of deposition parameters for practical applications. (auth)

24665 INVESTIGATION INTO THE CONSTITUTION OF THE MOLYBDENUM–TUNGSTEN–BORON SYSTEM. Roesch, J. D. Stuttgart, Ger.; Stuttgart Univ. (1973). 41p. (In German). INIS.

With figs.; 18 refs. With abstract. Available from the library of the Stuttgart Univ.

A device for optical differential thermal analysis is described. In this device, samples are heated inductively by high frequency where the melting temperatures of niobium, tantalum, molybdenum, or tungsten can be reached without difficulty. The maximum obtainable temperatures do not only depend on the output power of the generator but also on the vapor pressure of the alloys to be investigated as the analyses must be carried out in an inert gas atmosphere at 10^{-4} torr of argon. In order to limit or avoid the exceedingly fast reactions of the sample with the crucible material which mostly occur at high temperatures, they must be practically heated without a crucible. Therefore, contrary to the usual differential thermal analysis with thermoelements, no reference sample is prepared, and instead of using the temperature difference ΔT, the time differential quotient dT/dt is plotted against temperature. By using a high quality control of the filament power of the high frequency generator, accurate results are obtained despite the missing reference sample. The formation of the metal-rich part of the three-component system molybdenum–tungsten–boron up to about 50 at % boron was determined by thermal analysis with the equipment and by X-ray and microscopic investigations on quenched samples. The boundary systems were thermoanalytically checked and corrected if necessary. The smelt surface with the smelt flow process, the solid surface and four temperature concentration sections give a picture of the formation of the phase spaces. The system is governed by the extensive two-phase spaces (Mo,W) + $(Mo,W)_2B$ and $(Mo,W)_2B$ + (Mo,W)B(h) or (r). The phases $(Mo,W)_2B$ and (Mo,W)B(h) and (r) form uninterrupted mixed crystal rows from one boundary system to the next, whereas only a little tungsten dissolves in the Mo_2B_2 phase. With the model of the asymmetric regular solution, calculable values for the free excess enthalpy can be obtained in the quasi-binary section MoB–WB. In the ternary region, this calculation can be well used for interpolation. With the help of this process, with which non-directly measurable phase boundary lines of the system could also be determined, the smelt and solid surfaces as well as four temperature-concentration sections can be worked out. (auth)

24666 MECHANICAL PROPERTIES OF POLYCRYSTALLINE DYSPROSIUM FROM 78 TO 750 K. Owen, C. V.; Scott, T. E. (Ames Lab., IA). J. Less-Common Metals; 37: No. 3, 353-360 (Sep 1974).

The flow-stress temperature dependence, strain-rate sensitivity, strain-hardening exponent, and ductility of dysprosium were determined from 78 to 750°K at strain rates of 0.005, 0.01, 0.10 and 1.0 min^{-1}. The results are presented and similarities of some of the results to those obtained for other rare-earth metals are discussed. (auth)

24667 NEUTRON DIFFRACTION STUDY OF $Y_xLa_{1-x}(Co_yFe_{1-y})_5$ ALLOYS. Barrick, J. C. (Univ. of Missouri, Rolla); Simmons, M.; James, W. J.; Laforest, J.; Shah, J. S. J. Less-Common Metals; 37: No. 3, 379-386(Sep 1974).

Neutron diffraction studies and some complementary magnetic measurements have been made of $Y_xLa_{1-x}(Co_yFe_{1-y})_5$ intermetallic compounds to determine whether Co–Fe ordering occurred on the two non-equivalent crystallographic sites, 2c and 3g, of the $CaCu_5$-type structure. The easy axis of magnetization is found to be along $\vec{c}$. iH_c decreases and B_s increases when Fe is partially substituted for Co. Assuming that Y and La fully occupy the site 0, 0, 0 in a ratio of 7/3 for $Y_{0.7}La_{0.3}Fe_{0.8}Co_{4.2}$, the model which best fits both nuclear and magnetic intensities distributes the Fe and Co atoms randomly amongst the 2c and 3g sites. (auth)

24668 LATTICE PARAMETERS OF COMPOUNDS OF THE TYPE R. E. $Zn_{\sim 5}$ HAVING THE $CaCu_5(D2_d)$ STRUCTURE. Mason, J. T. (Ames Lab., IA). J. Less-Common Metals; 37: No. 3, 387-391(Sep 1974).

It is noted that M. L. Green [J. Less-Common Metals, 32: 391 (1973)] reported on preparation of RZn_5 compounds (R = Ce, Pr, Nd, Sm, Gd, Dy, and ER) having the $CaCu_5$ structure. Reasons for suspecting that these structures were not found are given. These include Green's inability to prepare single-phase alloys, lack of agreement between observed and calculated structural data, lack of a systematic volume vs ionic radius relation, and failure of any other workers to find these structures. (JRD)

24669 MAGNETIC PROPERTIES OF NEPTUNIUM LAVES PHASES: $NpAl_2$, $NpOs_2$, $NpIr_2$, AND $NpRu_2$. Aldred, A.T.; Dunlap, B.D.; Lam, D.J.; Nowik, I. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. B 10: No. 3, 1011-1019 (1 Aug 1974).

The magnetic properties of a series of neptunium cubic C-15-type Laves phases (NpX_2, where X = Al, Os, Ir, or Ru) have been studied between 1.5 and 300 °K by means of magnetization and nuclear γ-ray resonance measurements. The properties show a systematic variation with neptunium–neptunium distance d_{Np}. Thus, $NpAl_2$ (d_{Np} = 3.37 Å) is ferromagnetic with a transition temperature T_c = 56 °K and an ordered moment of 1.5μ_B/mole; $NpOs_2$ (d_{Np} = 3.26 Å) is ferromagnetic with T_c = 7.5 °K and an ordered moment of 0.4μ_B/mole; $NpIr_2$ (d_{Np} = 3.25 Å) is antiferromagnetic with T_c = 7.5 °K and an ordered moment of 0.6μ_B/mole; and $NpRu_2$ (d_{Np} = 3.23 Å) does not order magnetically down to 1.5 °K. This trend is interpreted in terms of an increase in the delocalization of the neptunium magnetic moment and the magnetic 5f electrons, as d_{Np} decreases. (auth)

24670 SURFACE ELECTRONIC PROPERTIES OF TUNGSTEN, TUNGSTEN CARBIDE, AND PLATINUM. Houston, J. E.; Laramore, G. E.; Park, R. L. (Sandia Labs., Albuquerque, NM). Science; 185: No. 4147, 258-260(19 Jul 1974).

The local electronic structures of the surface regions of tungsten, tungsten carbide, and platinum are compared. Contrary to the hypothesis that the platinum-like catalytic activity of tungsten carbide results from the contribution of carbon valence electrons to the 5d band of tungsten, the width of the unfilled portion of the d band increases on going from tungsten to tungsten carbide. (auth)

24671 NEUTRON DIFFRACTION STUDY OF THE MAGNETIC STRUCTURE OF ERBIUM. Habenschuss, M.; Stassis, C.; Sinha, S.K.; Deckman, H.W.; Spedding, F.H. (Ames Laboratory, U. S. Atomic Energy Commission and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. B 10: No. 3, 1020-1026 (1 Aug 1974).

The magnetic structure of high-purity single crystals of erbium has been studied by neutron-diffraction techniques. Although the general characteristics of the magnetic structure of erbium have been found to be in agreement with earlier measurements, several interesting new features have been observed. At 84.4 °K the c-axis moment orders in a sinusoidally modulated magnetic structure with wave vector along the c axis, and develops higher-order harmonics as the temperature is decreased below the Néel point. The third- and fifth-order modulations of the c-axis moment were of measurable intensity at temperatures as high as 75 and 55 °K, respectively. Higher-order harmonics up to the 17th order have been observed as the temperature was decreased down to 22 °K. At 52.4 °K the basal-plane moment was found to order in a spiral with wave vector equal to that of the c-axis moment. Third- and fifth-order harmonics of the basal-plane moment were observed between approximately 50 and 18 °K. At 18 °K a transition to a ferromagnetic spiral structure was observed; significant hysteresis effects were observed in the vicinity of this transition temperature. Significant short-range-order effects have been observed above the Néel and the basal-plane-ordering temperatures. The temperature dependence of the wave vector of the magnetic structure was found to exhibit a number of anomalies associated with commensurability of the magnetic periodicity with that of the lattice. The basic features of the temperature dependence of the wave vector are in good agreement, in the (84–18) °K temperature region, with the Elliott-Wedgewood theory. The temperature dependence of the c- and a-axis lattice constants has been measured and found to exhibit significant magnetostriction effects. (auth)

24672 FIZIKO-KHIMICHESKII ANALIZ SPLAVOV URANA, TORIYA I TSIRKONIYA. (Physical-Chemical Analysis of Alloys of Uranium, Thorium, and Zirconium). Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). 224p.

The results of new studies of phase diagrams, structures, phase transitions, and physical-chemical and thermoelectric properties of alloys of U, Th, and Zr are reported in this collection of 26 papers. Special attention is given to the different methods of construction of phase diagrams, their theoretical calculation with computers, and thermodynamic data. A separate abstract was prepared for each paper. (tr-auth)

For abstracts of individual papers see: 24521–24523, 24550, 24551, and 24673–24693.

24673 EXPERIMENTAL AND THEORETICAL METHODS FOR THE STUDY OF THE THERMODYNAMIC PROPERTIES OF γ SOLID SOLUTIONS OF URANIUM. Ivanov, O. S.; Vamberskii, Yu. V.; Udovskii, A. L. pp 5-19 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The emf method with liquid electrolytes for the study of U alloys is described. Theoretical hypotheses, determined on the basis of calculation of thermodynamic functions of the solid solutions, are reported. Requirements for the thermodynamic calculation of the physical properties of γ–U are compiled and evaluated. (tr-auth)

24674 THERMODYNAMICS OF γ SOLID SOLUTIONS OF URANIUM–MOLYBDENUM. Vamberskii, Yu. V.; Udovskii, A. L.; Ivanov, O. S. pp 20-37 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Results of a study of the thermodynamic properties of U–Mo systems by the emf method using liquid electrolytes in the temperature interval from 1048 to 1173°K are reported. On the basis of literature data and other values, concentration dependences of the physical characteristics of the bcc alloys, necessary for thermodynamic calculations, are constructed. The calculation results quantitatively agrees well with experimental data for the excess entropy of the mixture and agrees satisfactorily for the enthalpy and free energy of the mixture. The physical principles responsible for the double exchange of the sign of the excess entropy and change of sign of the enthalpy of the mixture as a function of the composition are determined. (tr-auth)

24675 THERMODYNAMICS OF γ SOLID SOLUTIONS OF URANIUM–NIOBIUM. Vamberskii, Yu. V.; Udovskii, A. L.; Ivanov, O. S. pp 37-54 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Babaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Results of experimental studies by the emf method using liquid electrolytes on the thermodynamic properties of the γ–U–Nb system at temperatures in the interval from 1048 to 1173°K are reported. A description is given of the characteristics of the solid solutions of γ–U–Nb necessary for the calculation of thermodynamic functions. Calculations of the physical characteristics are preceded by the processing of experimental data for the purpose of a supplementary verification of the physical concepts of the solution. Experimental data practically reproduce the calculated curves (with change of sign) of the excess entropy of the mixture as a function of composition. The thermodynamic properties of solid solutions of γ–U–Mo and γ–U–Nb are compared. (tr-auth)

24676 DEPENDENCE OF THE MODULUS OF ELASTICITY AND DEBYE TEMPERATURES ON THE TEMPERATURE, PRESSURE, AND ALLOYING. Udovskii, A. L.; Ivanov, O. S. pp 54-68 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Within the framework of the quasiharmonic theory, the dependences of the modulus of elasticity and Debye temperatures θ on the temperatures $T > \theta$ and pressure are obtained. The agreement of the dependence obtained with the available theoretical data on this question, based on different assumptions and written on different theoretical levels, is shown. The regularities obtained were used for the explanation of the concentration dependence of the modulus of elasticity and the Debye temperatures for solid solutions whose components have atoms differing in both values. (tr-auth)

24677 EFFECT OF TEMPERATURE AND CONCENTRATION DEPENDENCES OF THE MODULUS OF ELASTICITY ON THE FORM OF THE FUSION CURVE OF SOLID SOLUTIONS. Ivanov, O. S.; Udovskii, A. L. pp 68-91 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

From expressions of the free energy in the quasichemical approximation with consideration of the elastic energy, depending on the temperature, equations are obtained for the decay curves of the solid solution, spinodal curves. Different particular cases are examined on examples of 12 phase diagrams of binary systems (U–Nb, U–Zr, Zr–Nb, Ta–Zr, Hf–Ta, Au–Ni, Au–Pt, Pd–Rh, Ir–Pd, Pt–Ir, Cr–W, and Sb–As). Data are also presented for Ti–U and U–Mo systems. The maximum temperatures of the decay curves as a function of pressure are calculated. (tr-auth)

24678 COMPUTER CALCULATION OF CURVES OF PHASE EQUILIBRIUM OF SOLID SOLUTIONS IN BINARY URANIUM SYSTEMS. Ivanov, O. S.; Udovskii, A. L. pp 91-103 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

On the basis of the analysis of current assumptions relative to the calculation of phase diagrams, the concepts of the simplest statistical theory (the Becker model improved by B. Ya. Pines and I. L. Aptekar) are united with the concepts of solid state physics. From these proposed concepts, the solubility curves (decay curves) of the bcc solid solutions of eight uranium systems are calculated. The systems are U–Zr, U–Hf, U–V, U–Nb, U–Ta, U–Cr, U–Mo, and U–W. Comparison of the calculation results with experimental phase diagrams indicated the good or, in some cases, satisfactory quantitative agreement of the calculated and experimental curves. The basic factors responsible for the form of the calculated decay curves and the solubility curves of these systems are analyzed. (tr-auth)

24679 MUTUAL DIFFUSION IN BINARY AND TERNARY URANIUM-BASED SYSTEMS. Fedorov, G. B.; Smirnov, E. A.; Gusev, V. N.; Zhomov, F. I. pp 104-109 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The mutual diffusion, diffusion of components, and thermodynamic properties of a series of alloys of U with Zr, Nb, and Mo were studied. It is shown that within experimental error the Darken relation can be assumed correct for metallic systems with bcc structure. On the assumption that the Darken relation completely satisfactorily describes the process of mutual diffusion in binary systems, the mutual diffusion coefficients are calculated for the ternary U–Zr–Nb (at.% Zr: at.% Nb = 1:1) system. Analysis of literature data on the high-temperature study of creep showed that this process is controlled by the rate of the diffusion process. (tr-auth)

24680 X-RADIOGRAPHIC STUDY OF THE FINE STRUCTURE OF COARSE-GRAINED URANIUM. Levitskii, B. M., Rusakov, A. A.; Yudin, V. M.; Yal'tsev, V. N.; Sokolov, N. A. pp 110-113 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

By the method of diffraction micro x-radiography and microbeams it is shown that crystallites of coarse-grained αU with grain dimensions of 1 to 2 mm consists of first-order sub-grains with an average dimension of 100 μm with disorientation ~30′ which in turn includes second order grains with an average dimension of 10 μm with disorientation angle ~4′. (tr-auth)

24681 FRACTOGRAPHIC STUDY OF URANIUM ALLOYS WITH A SCANNING ELECTRON MICROSCOPE. Lyutina, E. M.; Shebatinov, M. P.; Zelenskii, I. V.; Gomozov, L. I. pp 113-119 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The surfaces of crushed U alloys in different structural states after short-time (at room temperature) or extended (at 500 and 600°C) tests on stretching were studied with a scanning electron microscope of the JSM-U3 type in the secondary electron regime at amplifications up to 10,000. It was shown that alloying U with Nb and Al leads to a displacement of the mechanism of rupture, characteristic for U up to 520°C, in the very high temperature region (600°C). For U alloys with structure of supersaturated α'_a or α'_b solid solution, tested on ruptures at 20°C, ruptures by quasi-fractures and fusion of microvoids correspond to the ductile state (expansion ~10%) and ruptures by intergrain dissociation correspond to the brittle state (expansion 1.6%). (tr-auth)

24682 INTERACTION OF URANIUM CARBIDES WITH TRANSITION ELEMENTS OF THE VI AND VII GROUPS (Cr, Mo, W, Mn, Tc, AND Re). Ivanov, O. S.; Alekseeva, Z. M. pp 120-122 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The results of a study of six phase diagrams of ternary systems including U, C, and one of the transition metals are generalized. On the basis of the classification a capacity for forming ternary chemical compounds from these three elements are proposed. Thirteen ternary chemical compounds detected in these systems are tabulated and their crystallographic characteristics are given. (tr-auth)

24683 STRUCTURE OF ALLOYS OF THE URANIUM CORNER OF THE U–Fe–Th SYSTEM. Badaeva, T. A.; Aleksandrova, L. N. pp 123-129 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Projections of the liquidus surface and phase diagrams of the U corner of the U–Fe–Th system were constructed by methods of thermal and microstructural analysis and by measurement of the hardness and microhardness. The presence of two peritectic and one eutectic equilibrium at temperatures of 805, 800, and 720°C, respectively, was established. The existence of a ternary phase T formed by peritectic reaction at ~1045°C in alloys of the quasibinary cross section UFe_2–Th is shown. Stratification in the liquid state, established in the binary system U–Th, was not detected in ternary alloys containing 2 at. % Fe. (tr-auth)

24684 DEVELOPMENT OF THE $\gamma \rightarrow \alpha'$ TRANSITION IN PREVIOUSLY QUENCHED ALLOYS OF THE U–Zr–Mo AND U–Nb–Mo SYSTEMS AS A RESULT OF TEMPERING, DEFORMATION, AND ANNEALING. Sofronova, R. M.; Kushnir, N. P.; Romanova, A. K. pp 129-135 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The plastic deformation of quenched ternary alloys of U–Zr–Mo and U–Nb–Mo stimulates the development of the $\gamma \rightarrow \alpha'$ transition. During tempering of the alloys with structure of the α'' phase, X alloyed predominantly with Nb and Mo, and alloys with structure of the γ^0 phase, whose compositions are close to the boundary of the α''/γ^0 phase, the reverse transition $\alpha'' \rightarrow \gamma^0 \rightarrow \gamma^s$ occurs. In alloys with high concentration of Zr and α'' structure the $\alpha'' \rightarrow \alpha'$ transition takes place directly. In alloys with γ^s structure the direct transition $\gamma^s \rightarrow \gamma^0$ occurs. In the process of annealing deformed alloys most of them undergo reverse transition, most noticeably in those alloys which undergo it during tempering. In alloys, inclined to reverse transitions, a high concentration of excess vacancies, set by quenching, can be assumed. (tr-auth)

24685 METASTABLE PHASES IN URANIUM ALLOYS QUENCHED FROM THE LIQUID STATE. Sofronova, R. M.; Kushnir, N. P.; Kobylkin, A. N. pp 135-139 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Quenching by the collapse of a drop of liquid metal between cooled Cu plates guarantees a cooling rate of the order of 10^{4b}/s in a large part of the temperature interval of cooling (up to ~500°C) and a rate commensurate with the quenching rate in water (~10^{3a}/s) at temperatures <200°C. Accordingly quenching from the liquid state of alloys with comparatively low temperature of the point M_s of the displaced $\gamma \rightarrow \alpha'$ transition (U–Mo) gives structures close to the structure of alloys of this composition quenched in water; in alloys with the temperature of the M_s point of 550 to 650°C (U–Zr and U–Zr–Nb) an increase of the cooling rate from 10^3 to 10^{4b}/s stimulates the development of the $\gamma \rightarrow \alpha'$ transition and fixes a lower temperature state than in quenching with water. Quenching from the liquid state of alloys of U + 20 to 30 at. % Ti leads to a two-phase state α' + a phase of the U_2Ti type with hexagonal structure close to the structure of the ω phase. (tr-auth)

24686 METASTABLE PHASES IN U–V, U–Rh, U–Os, AND U–Hf SYSTEMS AND SOME REGULARITIES IN THE FORMATION OF THESE PHASES IN URANIUM-BASED ALLOYS. Sofronova, R. M.; Kushnir, N. P. pp 139-145 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

During quenching from the γ region of alloys of U with V the β, α', and α'' phases are stabilized and in alloys with Rh the β and α' phases are stabilized. In U alloys in which a tendency to decay of the γ solid solution or to formation of compounds is not detected, the development of the $\gamma \rightarrow \alpha'$ transition during quenching is determined by the electron structure of the alloying metal and by the spatial relations in the lattice of the metastable phase. (tr-auth)

24687 INVESTIGATION OF THE FINE STRUCTURE OF ZIRCONIUM ALLOYS WITH 1 AND 2.5 AT. % Nb DURING COLD DEFORMATION, QUENCHING, AND ANNEALING BY THE METHOD OF HARMONIC ANALYSIS. Murav'eva, L. S.; Taraeva, E. M.; Kishenevskii, V. B.; Vladimirov, S. A. pp 146-153 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Investigation by the Fourier analysis method of the forms of the x-ray lines made it possible to trace the effect of the different forms of thermal and mechanical processing on the changes in the fine structure (dimensions of the region of coherent scattering and relative microstrain) of Zr alloys with 1 and 2.5 at. % Nb. It was established that cold rolling and quenching of the alloys from 900 and 800°C causes a significant reduction of the dimensions of the region of coherent scattering and an increase of the relative microstrain of the crystalline lattice. This is explained by the presence of deformation and phase cold hardening. Annealing of the cold-deformed alloy and tempering of the quenched alloy leads to a significant reduction of the relative microstrain which is connected with the removal of stress of the second type and with decay processes occurring in alloys during these treatments. (tr-auth)

24688 ISOTHERMAL CROSS SECTION OF THE PHASE DIAGRAM OF THE Zr–Mo–Co SYSTEM AT 900°C (ZIRCONIUM CORNER). Spektor, A. Ts.; Pet'kov, V. V. pp 160-163 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

An isothermal cross section of the phase diagram of the Zr–Mo–Co system at 900°C was constructed on the part adjacent to the Zr corner and limited by isoconcentrations with Mo and Co concentrations of 20 and 18 at. % respectively. The absence of K and ω phases in this concentration interval was established. The absence of the ω phase is indicated by the fact that equilibria between ω and β phases do not exist. The following phase regions were established: one-phase β, two-phase $\lambda_2 + \beta$ and $\eta + \beta$, and the three-phase $\lambda_2 + \eta + \beta$. The pattern of the limits of solubility of $\beta-(\eta + \beta)$ in the ternary Zr–Mo–Co system at 900°C was determined; its prominence is directed to the Zr corner. The solubility of Co in the β phase with small additions of Mo is sharply decreased. Mutual alloying of Zr with Mo and Co significantly strengthens the β phase (the greatest microhardness of the β phase is found in alloys with 1.5 at. % Mo and 2.7 at. % Co and is 650 kg/mm^2). (tr-auth)

24689 CREEP PARAMETERS OF URANIUM–MOLYBDENUM γ SOLID SOLUTION. Gomozov, L. I.; Makhova, V. A.; Ivanov, O. S. pp 192-197 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The creep under stretching of uranium alloys containing up to 24 at. % Mo was studied. The test temperatures (720 to 840°C) were 0.6 to 0.7 T_m and the stress (1 to 3 kg/mm^2) was about 10^{-4} of the shearing modulus. For alloys containing up to ~15 at. % Mo, an abnormally low creep rate and high activation energy were observed. This characteristic is presumably connected with the presence of a short-range order sharply decreasing with increase of temperature. The activation energies for mutual diffusion and creep (for alloys previously stabilized in the γ phase) practically coincide. In proportion to the increase of the Mo concentration the sensitivity to stress n decreases from 4 to 4.5 down to ~1. Probably dislocation-diffusion and "pure" diffusion mechanisms give comparable contributions to the deformation. Immediately after transition from the heterophase to the γ state abnormally low values of the activation energies and reduced values of n were observed. This was explained by the high concentration of non-equilibrium vacancies. (tr-auth)

24690 THERMOELECTRICAL PROPERTIES OF LOW-ALLOYED Th- AND Mn-BASED ALLOYS. Terekhov, G. I.; Tagirova, R. Kh. pp 197-200 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Alloying Th with Mn does not change substantially the values and signs of the absolute thermo emf of Th. Resistometric and metallographic studies of the alloys showed that the solubility of Mn in Th at 500°C is less than 1 at. %. (tr-auth)

24691 THERMOELECTRIC PROPERTIES OF γ SOLID SOLUTIONS OF U–Mo SYSTEMS. Terekhov, G. I.; Sinyakova, S. I.; Ivanov, O. S. pp 200-204 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The thermoelectric properties of γ solid solution of the U–Mo system were studied. In the concentration interval from 4.5 to 5.5 at. % Mo values of the thermo emf of the order of 35 to 40 μ vol. % were found. This is abnormally high for metallic materials. In agreement with experimental data U-based γ-solid solutions with Mo must have almost complete filling of the Brillouin zone. (tr-auth)

24692 THERMOELECTRIC PROPERTIES OF U–Cr γ SOLID SOLUTIONS. Terekhov, G. I.; Sinyakova, S. I. pp 205-207 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The thermoelectric properties of γ solid solutions of the U–Cr system were studied. It was shown that small additions of Cr significantly increases the absolute thermo emf of U. The increase of the thermo emf and its positive sign is explained by the strong interaction of the Fermi surface with the boundaries of the Brillouin zone. (tr-auth)

24693 SOME EFFECTS OF MACROADDITIONS OF CERIUM AND YTTRIUM ON THE PROPERTIES OF ZIRCONIUM ALLOYS WITH 1 AND 2.5 AT. % NIOBIUM AND ALSO THESE ALLOYS CONTAINING OXYGEN. Tararaeva, E. M.; Murav'eva, L. S. pp 208-211 of Fiziko-Khimicheskii Analiz Splavov Urana, Toriya i Tsirkoniya. Badaeva, T. A. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The alloying of alloys with 1 and 2.5 at. % Nb with and without oxygen with Ce and Y was studied. The effect of the latter on the corrosion stability in water at 300°C and steam at 400°C and the mechanical properties at room temperature and 400°C was studied. Alloying leads to an increase of the strength characteristics and significantly reduces the corrosion rate. The optimum association of corrosion and mechanical characteristics was noted only in alloys with 2.5 at. % Nb and 0.25 at. % Ce. (tr-auth)

24694 CREEP RUPTURE. Sainfort, G. (CEN, Grenoble, France). Qual., Rev. Prat. Contr. Ind.; No. 60, 69-76(Apr 1973). (In French).

From meeting on fractography; Paris, France (6 Mar 1973).

Creep rupture is a very important phenomenon in materials subjected to vibrations at high temperature. The rupture time and the ductility at rupture can be considerably reduced in relation to the values extrapolated from tests at low temperatures. The experimental results were used to study intergranular rupture and the effects of certain parameters (temperature, stresses, rate of deformation, radiation effects...) on rupture. (FR)

24695 X-RAY INTENSITY RATIOS IN THORIUM. Vano, E.; Gonzalez, L.; Gaeta, R.; Gonzalez, J. A. (Junta de Energia Nuclear, Madrid (Spain)). Phys. Lett., A; 48: No. 1, 25-26(20 May 1974).

Some x-ray intensity ratios for thorium have been measured using a thin uniform ^{238}U source and a Ge(Li) low energy photon spectrometer. In contrast with the general trend displayed by previous experimental data, the measurements for thorium are 10-40% greater than the Scofield theoretical calculation. (auth)

24696 EFFECT OF ZIRCONIUM ON THE STRENGTH OF THORIUM. Peterson, D. T.; Zabel, D. C. (Ames Lab., IA). Met. Trans.; 5: No. 5, 1173-1177(May 1974).

The flow stress of thorium–zirconium alloys containing up to 12 at. % zirconium was studied over a range of temperatures and strain rates. It was found that the flow stress could be analyzed as the sum of a thermally activated and an athermal component. The thermally activated component was nearly the same in the base metal and the zirconium alloys. The major effect of zirconium was a considerable increase in the athermal component. The magnitude of this increase was directly proportional to the zirconium content. Zirconium also retarded the recovery and recrystallization processes. (auth)

24697 STRESS EXPONENT AND THE RATE-CONTROLLING MECHANISM OF HIGH-TEMPERATURE CREEP IN SOME SOLID SOLUTIONS. Oikawa, H.; Karashima, S. (Tohoku Univ., Sendai). Met. Trans.; 5: No. 5, 1179-1182(May 1974).

The internal stress, σ_i, and the effective-stress exponent of the dislocation velocity, m*, have been determined during creep of Fe–3.5 at. % Mo alloy at 1123°K under 10.8 to 39.2 MN/m^2 and of Ni–10.3 at. % W alloy at 1173°K under 19.6 to 88.2 MN/m^2. Both alloys have been classified among class I alloys under a certain condition including the present one, because the applied-stress exponent of the steady-state creep rates, n, is almost 3. Values of σ_i obtained by stress-transient dip test were small and almost independent of the applied stress, σ_c, in Fe–3.5 Mo alloy. On the other hand, in Ni–10.3 W alloy σ_i increased with increasing σ_c as in the case of many pure metals. The value of m* obtained by analyzing stress-relaxation curves immediately after creep deformation was unity in Fe–3.5 Mo alloy, whereas in Ni–10.3 W alloy it was about 2.5. These results indicate that the rate-controlling mechanisms in creep are different from each other in these two alloys and that the classification according to n-value does not always coincide with the classification according to the rate-controlling mechanisms. It is concluded that the fact that $n \simeq 3$ is not a sufficient evidence supporting that creep is controlled by one of the microcreep mechanisms. (auth)

24698 RECRYSTALLIZATION AND TEXTURE FORMATION IN COLD-ROLLED DYSPROSIUM SHEET. Hopkins, R. H.

(Westinghouse Research Labs., Pittsburgh). Met. Trans.; 5: No. 5, 1183-1188(May 1974).

The primary recrystallization of dysprosium can be characterized by an apparent activation energy of 13.4 ± 1.4 kcal/mole when specimens are isothermally annealed at temperatures between 400 and 600°C. At temperatures between 300 and 400°C recrystallization is strongly retarded, possibly by precipitation, and the activation energy associated with the process is increased to 31.4 ± 4 kcal/mole. The deformation texture of dysprosium sheet following a cold reduction of 50% can be described as $(0001)\langle 10\bar{1}0\rangle$ with a rotational spread of 15 to 20° about the rolling direction. Annealing the rolled sheet produces a recrystallization texture which is composed of two components related to the deformation texture by 27° rotations about a common $10\bar{1}0$ direction. Within the scatter of the data this texture can be represented by the ideal orientation $\{1\bar{2}16\}\langle 10\bar{1}0\rangle$. (auth)

24699 EFFECT OF SURFACE CONDITIONS ON THE NORMAL SPECTRAL EMITTANCE OF TITANIUM AND ZIRCONIUM BETWEEN 1000 AND 1800°K. Baria, K. D. N. (North Dakota Univ., Grand Forks); Bautista, R. G. Met. Trans.; 5: 555-560 (1974).

The normal spectral emittance of Ti and Zr was obtained in the temperature range 1100 to 1800°K and wavelength 0.645 μ for electrochemically polished, mechanically polished, and 60 grit ground surfaces at a pressure below 10^{-6} mm Hg. The emittance at the melting point was obtained by extrapolation from the experimental data for the electrochemically polished surface and was in good agreement with reported values. The considerable grain growth on the surface affected the emittance. The emittance was found to increase with temperature up to 1300°K and then decreased with further increase in temperature. (11 figures) (auth)

24700 SOLID-SOLUBILITY LIMIT OF OXYGEN IN Nb-RICH Nb-Zr ALLOYS. Ortali, P. L. (CNR, Milan); Jehn, H. Met. Ital.; 66: No. 5, 263-266(May 1974). (In Italian).

The solid solubility limit of oxygen in Nb-Zr alloys containing 2 and 5 at. % Zr has been investigated in the temperature range 1400 to 1900°C. The oxygen concentrations reach values in the range of 0.02-0.2 at. % and can be given by the equations: Nb-2 Zr: $C_0 = 1.9 \times 10^3 \exp(-38800/RT)$; Nb-5 Zr: $C_0 = 1.2 \times 10^3 \exp(-38800/RT)$; ($C_0$ in at. %; T in °K). Furthermore the equilibrium constant for the reaction [Zr] + 2 [O] = ZrO_2 to log Kp = −0.84 + 16960/T. (tr-auth)

24701 SOME ASPECTS OF WEAR-RESISTANCE IN CARBONITRIDED AND HARDENED LAYERS RELATING TO THE REMANENT CONTENT OF AUSTENITE. Secciani, A.; Costa, R.; Francia, V. (SITFA, Bologna). Met. Ital.; 66: No. 5, 275-282 (May 1974). (In Italian).

The following tests were carried out on eight 18 NiCrMo5 bars carbonitrided and hardened on different ways at the purpose of changing the remanent austenite at their surface and of measuring the friction coefficient relating to it through dry-wear tests by rolling-sliding friction with progressive and constant load. By increasing load from 25 up to 85 kg, the friction coefficient decreases and is independent from remanent austenite content and from the maximum carbon percentage. By long-time tests under a constant 10 kg load, the friction coefficient remains unchanged after about 60 minutes of road-in time, thus confirming once again the independence of it from the remanent austenite and from the maximum carbon content. (tr-auth)

24702 IMPACT TOUGHNESS AND COLD SHORTNESS OF TsM-5 MOLYBDENUM ALLOY. Malkhasian, N. M. Metalloved. Term. Obrab. Metal.; No. 1, 63(1974). (In Russian).

24703 LOW TEMPERATURE CREEP OF Ti-6 Al-4 V. Odegard, B. C.; Thompson, A. W. (Sandia Labs., Livermore, CA). Met. Trans.; 5: No. 5, 1207-1213(May 1974).

Creep tests were conducted at 295°K on Ti-6Al-4 V in the solution treated and aged (4 h at 815°K) condition, and in the as-welded condition. Some aged specimens were tested after pre-straining. Creep stresses ranged from 40 to 90% of the aged material yield strength. Results showed that creep was of the primary or transient kind in all cases, and was much greater in welded than in aged material. In general, pre-strains reduced creep, although a strain larger than 10^{-3} was needed to do this at the highest creep stress. Activation areas A* were between 10 and 20 b^3, and thus were similar to tensile results on titanium and its alloys. The microstructural rationale applied to Ti-5Al-2.5 Sn in earlier work, based on the character of dislocation sources, proved successful in understanding the effects of prestrain in this work. (auth)

24704 IMPURITY CONTROLLED DIFFUSION REACTION IN THORIUM-VANADIUM SYSTEM. Raghunathan, V. S.; Patil, R. V.; Khera, S. K.; Sharma, B. D. (Bhabha Atomic Research Centre, Trombay, India). Met. Trans.; 5: No. 5, 1141-1148(May 1974).

The effect of ppM level impurities present in the thorium metal on the diffusion reaction in thorium-vanadium system has been investigated by making sandwich type diffusion couples and annealing them in the temperature range of 900 to 1200°C. The microstructure of the diffusion zone has been examined by optical and electron microscopy. X-ray powder techniques have been employed to detect the presence of secondary intermetallic phases in thorium metal and in the diffusion zone. The chemical composition of these phases and the elemental distribution in the diffusion zone have been established by using an electron microprobe analyzer. The time and the temperature dependence of the diffusion zone width is used to evaluate the kinetics of layer growth. Present studies have shown that impurities such as iron, copper, and aluminum form low melting point intermetallic compounds in thorium metal and segregate at the grain boundaries. Further in a diffusion reaction at the elevated temperatures, these thorium rich secondary phases melt and form a liquid film between the thorium and the bonding metal, vanadium in the present case. The rate controlling process appears to be an interfacial chemical reaction involving dissolution of vanadium in the thorium rich liquid. (auth)

24705 INFLUENCE OF MACHINING TEMPERATURE ON THE SURFACE DAMAGE, RESIDUAL STRESS, AND TEXTURE OF HOT-PRESSED BERYLLIUM. Rennhack, E. H. (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA). Met. Trans.; 5: No. 5, 1095-1101(May 1974).

The effect of lathe machining temperature ranging from room to 400°C on the depth of twinning, extent of microcracking, residual stress, and texture of hot-pressed, S200-type beryllium was investigated. It was shown that twinning, microcracking, and residual stress were essentially eliminated when machining was performed above the ductile-to-brittle fracture transition range at 400°C. This behavior has been related to the operation of multiple slip systems, which, in terms of the von Mises criterion, satisfies the condition for uninhibited deformation. Minimization of residual stress was attributed to recovery resulting primarily from dislocation annihilation and climb, the latter giving rise to the formation of well-defined low-angle boundaries and stable hexagonal networks adjacent to the machined surface. (auth)

24706 INFLUENCE OF GAS ENVIRONMENTS ON FATIGUE CRACK GROWTH RATES IN TYPES 316 AND 321 STAINLESS STEEL. Mahoney, M. W.; Paton, N. E. (Rockwell International Science Center, Thousand Oaks, CA). Nucl. Technol.; 23: No. 3, 290-297(Sep 1974).

Fatigue crack growth rates of Types 316 and 321 stainless steel were studied as a function of stress intensity, temperature, relative humidity, and gas environment. At 25°C, humidity in the presence of oxygen accelerates crack growth rates by a factor of ~1.7, as compared to an inert environment (N_2 or Ar). A threshold level is implied for the effect of humidity above which further increases in moisture content have no additional influence. At 649°C, an air environment was found to increase crack growth rates by factors of ~22 and ~5 for Types 316 and 321 respectively, over rates in either Ar or N_2. Crack growth rates in N_2 and Ar at 649°C were comparable to crack growth rates at 25°C, leading to the conclusion that increased growth rates at 649°C in air are principally a result of environmental interactions with the crack front rather than a result of reduced mechanical properties at 649°C. These results also show that Type 321 is less susceptible than Type 316 to aggressive environments at 649°C such as room air, suggesting that Type 321 might be a better choice of material for some elevated temperature applications. Fractography of specimens tested at 649°C revealed the absence of striation formation for specimens tested in inert environments, while pronounced striations were found in environments such as air. (auth)

24707 PRESENT USES AND FUTURE POSSIBILITIES OF TITANIUM AND ITS ALLOYS, WITH REFERENCE ALSO TO ECONOMICS AND MATERIALS POLICY. Strocchi, P. M. (CNR, Milan). Met. Ital.; 66: No. 6, 337-353(Jun 1974). (In Italian).

After a short introductory remark an estimate is made on the possible use of titanium and its alloys with particular reference to the non-aerospace applications. The most important physical-metallurgical properties are summarized together with a very concise survey of the metallurgical process technologies. Some areas in which titanium and its alloys can successfully be employed are analyzed, with emphasis on those susceptible of substantial development in the future. (auth)

24708 STUDY OF THE MAGNETIC STRUCTURE OF CeSb AND GdSb USING MOESSBAUER SPECTROSCOPY ON ^{121}Sb. Shenoy, G. K. (CNRS, Strasbourg); Friedt, J. M.; Dunlap, B. D.;

Vogt, O. J. Phys. (Paris), Colloq.; No. 1, 43-44(1974). (In French).

From meeting on hyperfine interactions as detected by nuclear radiations; Liege, Belgium (11 Sep 1973).

The Moessbauer spectra of ^{121}Sb in CeSb and GdSb have been measured at 77 and 4.2°K. In the antiferromagnetic state of CeSb (T_N = 16°K), an unique saturation hyperfine field of 64 ± 4 kOe is observed at the antimony nucleus, indicating that the magnetic structure of CeSb in either type I or type IA. This is in agreement with the neutron diffraction work which predicted a structure of type IA. The origin for the difference in the hyperfine magnetic field at Sb in CeSb and USb is discussed. The magnetic hyperfine field at the antimony nucleus in GdSb in its antiferromagnetic state is zero. The magnetic structure of GdSb deduced to be type II. (FR)

24709 IMPLANTATION IN DILUTE ALLOYS. Benoit, A.; Flouquet, J.; Sanchez, J. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 1, 17-18(1974). (In French).

From meeting on hyperfine interactions as detected by nuclear radiations; Liege, Belgium (11 Sep 1973).

Nuclear orientation experiments on implanted samples of $Au^{175}Yb$ and $Au^{169}Yb$ and on implanted single crystals of $Mg^{137m}Ce$ show clearly that the effects of the defects are important for the implanted sample whatever the solubility of the impurity. (FR)

24710 MICROSTRUCTURAL ANALYSIS: TOOLS AND TECHNIQUES. Proceedings of the Symposium Held in Chicago, Illinois, September 17 – 18, 1972. McCall, J. L.; Mueller, W. M. (eds.). New York; Plenum Publishing Corporation (1973). 349p. (CONF-7209118-). $22.50.

Recent work and techniques in the fields of scanning electron, transmission, and ion microscopy applicable to microstructure and metallographic analysis of reactor and aerospace materials are reviewed. Also described are other investigative techniques such as low-energy electron diffraction, Auger electron analysis, and ion scattering spectrometry. (SFL)

24711 REPLY TO: COMMENTS ON STAGE III AND STAGE IV ANNEALING MECHANISMS IN MOLYBDENUM. Stals, L.; Nihoul, J.; Cornelis, J.; De Meester, P. (SCK-CEN, Mol, Belgium). Scr. Met.; 8: No. 7, 777-780(Jul 1974).

Reference is made to a note by J. H. Evans [Scripta Met., 8, 773 (1974)] in which he rejects arguments used in papers by Stals et. al. [Phys. Stat. Sol. (a) 18,283 (1973)] concerning annealing mechanisms in Mo. It is noted that in the light of current models for work-hardening, a plausible assumption would be that the mechanism of nonconservative jog movement, favoring vacancy production, would predominate at lower deformation, whereas the mechanism of annihilation of edge dislocations with opposite sign, producing equal amount of vacancies and interstitials, would predominate at higher deformation degrees. On this basis, the increasing relative importance of Stage IV with respect to Stage III, with decreasing strain, would find a natural explanation in the interstitial model for Stage III. It thus appears that Evans' comments do not invalidate conclusions by Stals et. al. (JRD)

24712 COMMENTS ON STAGE III AND STAGE IV ANNEALING MECHANISMS IN MOLYBDENUM. Evans, J. H. (Danish Atomic Energy, Riso). Scr. Met.; 8: No. 7, 773-776(Jul 1974).

A note is presented to demonstrate that the arguments of Stals et. al. [Phys. Stat. Sol. (a) 18,283 (1973)] for interstitial migration in stage III annealing of Mo are not supported by data. (JRD)

24713 ELECTRON METALLOGRAPHY OF CAST CoCrNiTa ALLOYS WITH VARYING TANTALUM CONTENT. Rowe, A. P. Ann Arbor, MI; Univ. of Michigan (1973). 142p. University Microfilms Order No. 74-15,842.

Thesis (Ph. D.).

An investigation was conducted to examine the structural characteristics of a series of CoCrNiTa alloys and to study their relation to the mechanical properties of the alloys. The alloy series consisted of a base containing 40% cobalt, 30% chromium, and 30% nickel by weight, to which was added varying amounts of tantalum. The mechanical properties, namely the 0.2% offset yield strength, the ultimate tensile strength, and the elongation, of a series of alloys containing up to 16.7% tantalum had been determined in a previous investigation [Mohammed, H. M. and Asgar, K., J. Dent. Res., 52:145-150, (1973)] and showed abrupt increases in strength and decreases in ductility as the tantalum content was increased from 9.1% to 13.8%. Five alloy compositions were selected for electron metallographic study, containing 0, 9.1, 13.0, 13.8, and 16.7% tantalum. Specimens were prepared in the form of plates having two different thicknesses, 0.6 mm and 2.5 mm, in order to study the effect of different cooling rates, as well as in the form of tensile bars. The as-cast specimens were polished mechanically and electrolytically and examined by electron diffraction, scanning and transmission electron microscopy, and quantitative x-ray analysis to determine their phases, the composition of the phases, and the microstructural features as a function of tantalum content and casting cross-section. In addition, a series of specimens was examined after heat treatment at 700°C for 20 hours and both longitudinal and transverse sections of tensile bars which had been pulled to failure were examined for evidence of the fracture mechanisms. The alloys consisted primarily of a face-centered cubic matrix phase called alpha and an interdendritic hexagonal phase called beta. Both phases contained all four component elements; the major difference in composition was that the alpha phase contained 3 to 13% tantalum in the various alloys whereas the tantalum content of the beta phase ranged from 39 to 51%. Some of the alloys contained needles of a phase designated as sigma, and all contained spherical inclusions which were very high in tantalum. In the higher-tantalum, thicker castings and in heat-treated specimens, a fine precipitate phase designated as α-Co_3Ta was present in the alpha matrix phase and coherent with it. In addition, β-Co_3Ta and γ-Co_3Ta precipitates were found in both the alpha and beta matrix phases of the heat-treated specimens. From the results of the various examinations of these specimens it was concluded that: (1) The increasing strength of this alloy series as the tantalum content increases reflects first an increase in solid solution strengthening by the comparatively large tantalum atoms and then, as the tantalum content is increased from 9.1 to 13.8%, a precipitation strengthening effect by the concentration and arrangement of the tantalum atoms to form a fine, coherent α-Co_3Ta precipitate in the fcc matrix of the alloys. (2) The decreasing ductility of this alloy series as the tantalum content increases arises from the increasing amount of interdendritic hcp phase, which changes from a volume fraction of 0.19 to 0.41 in the 0.6 mm castings and from 0.16 to 0.37 in the 2.5 mm castings. The sigma phase needles and high-tantalum spheres appeared not to serve as crack initiators. (3) In every case the thinner castings of this series of alloys contained more hcp beta phase than did the thick castings of the same composition, less tantalum in the alpha phase, and less development of the fine coherent α-Co_3Ta precipitate. Hence it is predicted that the thinner areas in a casting will be less ductile and less strong than the thicker areas. Alloys with more desirable properties could be produced by a slower cooling of the ingot since in an alloy of a given composition slower cooling should result in greater development of the precipitation process, thereby increasing the strength, and in less hcp beta phase, thereby increasing the ductility. (Diss. Abstr., Int., B)

24714 ELECTRONIC PROPERTIES OF CRYSTALLINE SOLIDS. An Introduction to Fundamentals. Bube, R. H. New York; Academic Press, Inc. (1974). 534p.

Information on electronic properties of solids is presented in chapters on classical waves, wave approach to quantum mechanics, quantum mechanical treatment of simple systems, free-electron model of metals, origin of energy bands in solids, properties of energy bands, carrier transport, scattering processes, localized energy levels, magnetic field effects, optical absorption, and photoelectric effects. (JRD)

Radiation Effects

Refer also to abstracts 25459, 25613, 25861, and 25873.

24715 (AED-CONF-73-051-005) THE RECOVERY OF THE ELECTRIC RESISTIVITY OF NIOBIUM AFTER ELECTRON IRRADIATION AT 4.5°K. Faber, K.; Schultz, H. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Theoretische und Angewandte Physik; Max-Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany). Inst. fuer Physik). 1973. 5p. (In German). INIS.

From spring meeting of the solid state physics division of the Deutsche Physikalische Gesellschaft e.V.; Muenster, F. R. Germany (19 Mar 1973).

4 figs.; 10 refs.

The recovery of the electric resistivity of high-purity and doped Nb and 3-MeV electron irradiation was studied in order to find those stages in the recovery spectrum which are due to the migration of intrinsic defects. The residual electric resistivity ratio was 5 to 10,000. (GE)

24716 (AED-CONF-74-089-019) CHANGES IN LATTICE PARAMETERS AND RESIDUAL RESISTANCE OF PLATINUM AFTER IRRADIATION WITH ELECTRONS AT 4.5°K AND THERMAL RECOVERY. Hertz, W. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). 1974. 5p. (In German). INIS.

From spring meeting of the working group solid state physics of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

4 figs.; 1 tab. With abstract.

For platinum, a complete set of values has been determined experimentally concerning the change of volume and electric residual resistance per vacancy and per interstitial atom. (GE)

24717 (AED-CONF-74-089-023) INFLUENCE OF INTERSTITIAL IMPURITIES ON THE RECOVERY SPECTRUM OF NIOBIUM AFTER REACTOR IRRADIATION AT 4.6°K. Vavra, F.; Doenitz, W.; Boening, K. (Karlova Universita, Prague (Czechoslovakia). Fakulta Technicke a Jaderne Fysiky). 1974. 6p. (In German). INIS.

From spring meeting of the working group solid state physics of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

4 figs.

The recovery of the residual resistivity of niobium wires doped with oxygen or nitrogen was studied. The recovery in the doped samples is strongly suppressed in the ranges of 50°K to 160°K and enhanced above 250°K. This behavior is interpreted as similar to known recovery models for fcc metals. (auth)

24718 (AED-CONF-74-089-033) THE ASSEMBLAGE OF POINT DEFECTS IN COPPER AFTER NEUTRON IRRADIATION AT 4.6°K. Guerard, B. V.; Peisl, H. 1974. 4p. (In German). INIS.

From spring meeting of the Working Group Solid State Physics of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

4 figs.

When there are lattice distortions statistically distributed in a monocrystal with a concentration not too high, diffused scattering from the vicinity of a reciprocal lattice point reveals the remote displacement field of the defect. Diffused x-ray scattering experiments are reported using copper monocrystals which were irradiated with neutrons at very low temperatures. (GE)

24719 (AED-CONF-74-089-038) THE INFLUENCE OF IMPURITIES ON THE RECOVERY SPECTRUM OF TUNGSTEN AT LOW TEMPERATURE. Dausinger, F.; Schultz, H.; Boening, K.; Vogl, G. (Max-Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany); Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). 1974. 7p. (In German). INIS.

From spring meeting of the working group solid state physics of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

3 figs.; 1 tab.; 13 refs. With abstract.

The recovery spectrum of zone-melted W monocrystals (0.7 mm diameter, resistivity ratio 27,000) of different purity was redetermined after fast neutron irradiation at 4.5°K. (GE)

24720 (AED-CONF-74-089-039) THE RECOVERY SPECTRUM OF NIOBIUM AND TANTALUM AFTER LOW-TEMPERATURE ELECTRON IRRADIATION. Faber, K.; Schweikhardt, J.; Schultz, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany)). 1974. 14p. (In German). INIS.

From spring meeting of the working group solid state physics of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

The recovery of the electric residual resistivity of high-purity and doped Nb and Ta after 3 MeV electron irradiation at 4.5°K was investigated in order to find out those stages in the recovery spectrum which are due to the migration of intrinsic defects. The residual resistivity ratio of the high-purity samples was 5 to 10,000. (GE)

24721 (AI-AEC-13129) VOID FORMATION IN COLD-WORKED TYPE 316 STAINLESS STEEL IRRADIATED WITH 1-MeV PROTONS. Keefer, D. W.; Pard, A. G. (Atomics International Div., Canoga Park, Calif. (USA)). 28 Jun 1974. Contract AT(04-3)-824. 29p. Dep. NTIS $4.00.

Cold-worked Type 316 stainless steel was irradiated at 500 and 600°C with 1-MeV protons. The dependence of void formation on displacement damage, irradiation temperature, and microstructure was studied by transmission electron microscopy. Cold working delays the onset of swelling and reduces it, via a reduction in void size, at both irradiation temperatures. Inhomogeneity in the cold-worked microstructure leads to inhomogeneity in the disposition of voids. Swelling at 600°C is greater than at 500°C; the voids are less numerous, but larger, at the higher temperature. No change in the cold-worked microstructure can be detected by transmission electron microscopy after 500°C irradiation to 23 displacements per atom (dpa). Irradiation to a comparable damage level at 600°C results in almost complete elimination of the cold-worked microstructure. Comparison is made with reactor irradiation experiments. (8 figures) (auth)

24722 (AI-AEC-13130) EFFECT OF NEUTRON IRRADIATION ON TYPES 316, 321, AND SANDVIK 12R72 STAINLESS STEELS. Garr, K. R.; Pard, A. G.; Kramer, D. (Atomics International Div., Canoga Park, Calif. (USA)). 28 Jun 1974. Contract AT(04-3)-824. 20p. Dep. NTIS $4.00.

Samples of Types 316, 321, and Sandvik 12R72 stainless steels were irradiated in EBR-II to a fluence of 3.5×10^{22} n/cm^2 (E > 0.1 MeV) at 500 and 600°C. Most of the samples were Type 316 stainless steel, either cold rolled or solution annealed and aged. The other alloys were in either a solution-annealed or solution-annealed-and-aged condition. Immersion density and transmission electron microscopy (TEM) results showed that cold rolling prior to irradiation reduces the amount of swelling observed. For samples in the annealed condition and irradiated at 500°C, there was essentially no difference in swelling for the three alloys. After irradiation at 600°C, however, TEM of foil samples of Type 321 revealed very few voids, with essentially no swelling. Irradiation-induced precipitates whose size, type, and density varied with alloy, irradiation temperature, and previous treatment, were present in all alloys. The dislocation structure of the cold-worked samples was essentially unchanged after the 500°C irradiation, but was significantly altered during the 600°C irradiation. Results of tensile tests showed an increase in the yield strength and a decrease in the total elongation for samples irradiated in an annealed condition, whereas samples irradiated in the cold-rolled condition showed the reverse effect. (6 tables) (DLC)

24723 (CONF-740606-19) STRESS AND DEFORMATION ANALYSIS OF IRRADIATION INDUCED SWELLING. Winkel, B. V. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1974. Contract AT(10-1)-1375. 23p. Dep. NTIS $4.25.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

Nuclear reactor components may accumulate significant stresses and deformations in response to irradiation induced swelling. Failure to accommodate these swelling deformations may compromise the performance of the reactor. Also, if high swelling stresses coincide with irradiation induced embrittlement, fracture may occur. Experience gained with swelling at the Advanced Test Reactor is summarized. A suggested analysis procedure is outlined and demonstrated with a three-dimensional finite element analysis. Design aspects related to radioinduced swelling are also discussed. (auth)

24724 (CONF-740827-1) EFFECTS OF PROTON BOMBARDMENT ON SELF-DIFFUSION IN SILVER: A PRELIMINARY REPORT. Lam, N. Q.; Rothman, S. J.; Merkle, K. L.; Nowicki, L. J.; Dever, D. J. (Argonne National Lab., Ill. (USA)). 1974. 26p. Dep. NTIS $4.50.

From international conference on low temperature diffusion; Yorktown Heights, New York, USA (12 Aug 1974).

The radiation-enhanced self-diffusion coefficient (D_{rad}) in silver under 270-keV proton bombardment was measured over the temperature range from 240 to −60°C. The flux dependence of D_{rad} was also studied at 106 and 179°C with the flux varying from 2.5×10^{12} to 6.3×10^{13} protons/cm^2-sec. The experimental data are analyzed in the framework of the classical model involving single vacancies and interstitials as mobile defects. (auth)

24725 (HEDL-TME-73-74) HEAVY SECTION STEEL TECHNOLOGY PROGRAM TECHNICAL REPORT NO. 32. High Strain Rate Tensile Properties of Irradiated ASTM A533 Grade B Class I Pressure Vessel Steel. Steichen, J. M.; Williams, J. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1973. Contract AT(45-1)-2170. 33p. Dep. NTIS $4.00.

For Oak Ridge National Lab., TN.

The dynamic tensile properties of neutron irradiated A533-B steel have been characterized by high strain rate testing. Specimens were irradiated at a temperature of 510°F to fluences of approximately 0.5, 4.0, and 6.5×10^{19} n/cm^2 (E > 1.0 MeV). Test parameters for both control and irradiated specimens included strain rates from 6.7×10^{-5} to 100 s^{-1} and temperatures from −320 to 500°F. The results of these tests were correlated with a rate-temperature parameter (T 1n A/$\dot{\epsilon}$) to provide a concise description of material behavior for the range of deformation conditions of this study. The yield strength of both unirradiated and irradiated material was observed to significantly increase with decreasing temperature and increasing strain rate. At all temperatures increasing fluence increased the yield strength and decreased the rate sensitivity of A533-B steel. Ductility was significantly reduced at any temperature by increasing strain rate and fluence. Cleavage fractures occurred in irradiated specimens when the yield strength was elevated to the cleavage stress by fluence, temperature, and strain rate. (auth)

24726 (RD/B/N-2920) EXAMINATION OF ALLOY SPECIMENS IRRADIATED IN FUEL ELEMENT ASSEMBLIES OF THE DRAGON REACTOR. Pearce, R. J.; Horwood, R. A. L.; Sparry,

R. P. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Mar 1974. 29p. (RPC/CM/P-(74) 18). Dep. NTIS (US Sales Only) $4.50.

Specimens manufactured from various alloys have been exposed to the Dragon Reactor coolant at temperatures in excess of 750°C for periods of either 493 or 632 days. Examination of these has shown that only oxidation occurred on the Fe-Cr and Ni-Cr based alloys. This oxidation took the form of surface layer formation, with intergranular attack also occurring in the alloys containing aluminium and titanium. Samples of Monel 400 (a nickel-copper alloy) have also been examined. Considerable porosity was observed on surfaces exposed directly to the coolant gas, evidence being obtained that this was due to a loss of nickel. A comparison of these data and data from other sources shows that reaction rates in the very pure Dragon reactor atmosphere are much lower than those obtained in less pure atmosphere loop experiments. (auth)

24727 (RD/B/N-2975) VOID SWELLING IN STAINLESS STEEL WELD METAL. Buswell, J. T. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Mar 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

The void swelling characteristics of stainless steel weld metal have been examined. A weld bead of Armex GT, material specified as the filler metal for the welding of stainless steel 316, has been electron irradiated, at 575°C, in the as-welded and the as-welded + heat-treated (1 h at 1050°C) conditions. The swelling rates obtained were significantly lower than those of solution treated 316. Variations in swelling rate occurring within the weld bead were attributable to local variations in the material composition. It is unlikely that local swelling in a weld bead on a stainless steel fast reactor component will be detrimental to the overall performance of the component. (auth)

24728 (RT/FI-(74)5) FORMATION ENERGY OF VACANCIES IN ZIRCONIUM. Antonini, M.; Bortolani, V. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jan 1974. 24p. (In Italian). Dep. NTIS (US Sales Only) $4.25.

The vacancy formation energy of zirconium was calculated by means of a microscopic model which takes into account the electron-electron and electron-ion interaction. Result is in reasonable agreement with experimental data. Connections between the vacancy formation energy and the basic mechanisms for irradiation creep in this material are discussed. (auth)

24729 STUDY OF DIELECTRIC PROPERTIES OF UNTREATED, HEAT-TREATED, AND IRRADIATED AMORPHOUS Ge. Valkiainen, M.; Tiainen, O. J. A.; Suntola, T.; Naakka, H. (Technical Research Centre of Finland, Otaniemi). Phys. Status Solidi (a); 23: No. 1, K63-K65(16 May 1974).

Amorphous Ge on glass substrates was irradiated up to a fast neutron exposure of 7×10^{18} n/cm^2 (E > 10 keV) in a Triga Mark II core, while being cooled to <320°K. Capacitance and conductance were measured vs frequency (300 Hz to 3 MHz) after heat treatment and irradiation. The ratio ρ_2/ρ_1 increased on heat treatment and decreased on irradiation. The volume fraction of poorly conducting regions remained nearly constant. The dielectric properties can be explained with inhomogeneous conductivity inside the material. (DLC)

24730 LOW-TEMPERATURE FISSION NEUTRON DAMAGE IN V AND Mo. Vajda, P.; Biget, M. (CNRS, Orsay, France). Phys. Status Solidi (a); 23: No. 1, 251-260(16 May 1974).

Irradiations of vanadium and molybdenum were performed at liquid-hydrogen temperature with various fluences of fission neutrons. The results of the high-dose irradiation served to calculate the spontaneous recombination volumes of the two metals: α_r^{Mo} = 155 at. vol., α_r^V = 690 at. vol. when using the model of Lueck and Sizmann, and α_s^{Mo} = 210 at. vol., α_s^V = 810 at. vol. when applying that of Balarin and Hauser. The large differences between the recombination volumes for the two bcc metals are an argument against a simple lattice-structure dependence of α_r. The decisive role of ρ_F, the electrical resistivity of a Frenkel pair, is discussed in detail. The recovery spectra of both, V and Mo, were determined between 24 and 440°K, with the radiation-induced defect concentration as parameter. A tentative interpretation of the various annealing stages is given. (auth)

24731 OBSERVATION OF MAGNETICALLY ANISOTROPIC DEFECTS DURING STAGE I RECOVERY IN Ni AFTER LOW-TEMPERATURE ELECTRON IRRADIATION. Forsch, K.; Hemmerich, J.; Knoll, H.; Lucki, G. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (a); 23: No. 1, 223-230(16 May 1974).

An effort was undertaken to measure defect-induced changes of magnetic anisotropy in a nickel single crystal after low-temperature electron irradiation. A dynamic measuring method was used after reorienting a certain fraction of the radiation-induced defects in an external magnetic field of 5 kOe. In the temperature range of recovery stage $I_{C,D,E}$(45 to 60°K), the crystallographic direction dependence of defect-induced anisotropy could be determined. Results show that in this temperature range, the ⟨100⟩ split interstitial is mobile and able to reorient. The data are discussed with respect to existing information on magnetic after-effect and resistivity annealing in electron-irradiated nickel. (auth)

24732 SIMULATION OF IN-PILE IRRADIATION EFFECTS IN NICKEL AND AUSTENITIC STEELS BY BOMBARDMENT WITH INTERMEDIATE ENERGY Ni^+ IONS. Delaplace, J. (CEN de Saclay, Gif-sur-Yvette, France); Azam, N.; Le Naour, L.; Lott, M.; Fiche, C. J. Phys. (Paris), Colloq.; No. 5, 11-18(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

The formation of cavities in nickel by the agglomeration of vacancies (swelling) due to bombardment with 500-keV Ni^+ ions was studied. The swelling is temperature-dependent and passes through a maximum in the 620°C region. A prior charging of helium increases the number of cavities, but reduces the swelling. The swelling increases linearly with the fluence. The number and size of the cavities increase rapidly at the beginning of the irradiation. The behavior of the dislocation density of an austenitic steel bombarded with Ni^+ ions was studied. A high dislocation density was observed between 400 and 700°C. This density is independent of the initial state of the material (super-quenched or work hardened) and the fluence as soon as this latter factor reaches a value of 10 displacements per atom. It increases with increasing flux and decreases with increasing temperature. (FR)

24733 ELASTIC BULK EFFECT IN ELECTRON-IRRADIATED Cu AT VERY LOW TEMPERATURE. Lauzier, J.; Soulie, J. C.; Minier, C. (Centre d'Etudes Nucleaires, Grenoble, France). Phys. Status Solidi (a); 24: No. 1, K59-K61(16 Jul 1974).

High-purity Cu foils were irradiated with 2-MeV electrons below stage I_E, at 15 and 7.5°K. Internal friction and Young's modulus were measured during bombardment, together with the resistivity changes. Dislocation pinning is first observed, followed by saturation and linear decrease of frequency, which is characteristic of the elastic bulk effect. This effect is determined to be $\Delta M/Mc = -85 \pm 12$. (DLC)

24734 EFFECT OF ION BOMBARDMENT DURING DEPOSITION ON THICK METAL AND CERAMIC DEPOSITS. Bland, R.D.; Kominiak, G.J.; Mattox, D.M. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Vac. Sci. Technol. 11: No. 4, 671-674 (July 1974).

Energetic ion bombardment of metal and ceramic deposits during deposition is shown to affect the morphology, structure, stochiometry, and physical properties of the resulting deposit. The bombardment of the growing deposit tends to eliminate the columnar growth morphology normally encountered in thick-crystalline deposits. Generally, in metals it is found that internal stress, density, and gas content increase with increasing ion bombardment energy, but in some cases there is a decrease at high energies, possibly due to heating. In the case of sputter-deposited glass films, it is found that ion bombardment affects the stoichiometry, the coefficient of thermal expansion, and the strain point of the glass. Specific data are presented for thick (>1 μ) rf sputter-deposited Corning 1720 glass and also sputter-deposited and electron-beam ion-plated chromium deposits with both a dc and a rf substrate bias. (auth)

24735 DISLOCATION-DRAGGING EFFECTS IN QUENCHED AND ELECTRON-IRRADIATED COPPER. Simpson, H.M.; Kerkhoff, S.J. (Department of Physics, Wright State University, Dayton, Ohio 45431). Phys. Rev. Lett. 33: No. 3, 155-158 (15 July 1974).

Damping and modulus measurements were made on high-purity copper subjected to both quenching and 1.0-MeV electron irradiation. During isothermal annealing at room temperature, following quenching from 700 °C, we observe a monotonic decrease in the logarithmic decrement with a concurrent increase in the modulus. However, both slow cooling and quenching of the sample followed by 1.0-MeV electron irradiation give rise to a substantial increase in the decrement; i.e., the Simpson-Sosin "peaking effect" is clearly evident. (auth)

24736 INVESTIGATION OF STAINLESS STEELS FOR FAST NEUTRON REACTORS. III. Investigation in the Fiscal 1972 Entrusted by Power Reactor and Nuclear Fuel Development Corporation. Hasegawa, M. Tokyo; Power Reactor and Nuclear Fuel Development Corporation (1972). 152p. (In Japanese).

The objective was to collect reference data for research and development and for engineering design parameters, mainly regarding the irradiation behavior, and strength in liquid sodium of stainless steel. The stainless steel is a material for reactor containment, piping, reactor core construction, fuel sheaths, etc. of fast neutron reactors. The principal subjects are (1) the helium damage and swelling of stainless steel by neutron irradiation; (2) the change in mechanical properties such as tensile

strength, creep, fatigue, etc. by neutron irradiation; (3) the behavior of high alloy steel and super heat-resisting alloys under neutron irradiation; and (4) change in the mechanical properties of stainless steel in liquid sodium. The method of investigation is to study and review approximately 120 papers listed in the "Nuclear Science Abstracts". The date of original papers is 1970 to 1972. This report is the continuation part II. (JA)

24737 SWELLING IN NEUTRON IRRADIATED TUNGSTEN AND TUNGSTEN–25% RHENIUM. Matolich, J.; Nahm, H., Moteff, J. (Univ. of Cincinnati). Scr. Met.; 8: No. 7, 837-842(Jul 1974).

Results of neutron irradiation experiments on these materials are presented. It was found that atom displacements provide sites for precipitation in the collision cascade region in W–25 Re alloy while in W void induced swelling occurs. Results show that there is a difference in the swelling values obtained in diameter and corresponding length measurements. (JRD)

24738 ASYMMETRY IN YIELD STRESS AND IRRADIATION SOFTENING OF HIGH PURITY IRON SINGLE CRYSTALS. Sato, A.; Meshii, M. (Northwestern Univ., Evanston, IL). Scr. Met.; 8: No. 7, 851-860(Jul 1974).

Results of electron irradiation of Fe at about 50°K are reported. A strong orientation dependence and asymmetry in radiation softening was found. It is noted that in order to describe the irradiation results, a process of dislocation multiplication must be taken into account along with slip geometries and Schmidt factor. (JRD)

24739 STRAIN AGING IN IRRADIATED VANADIUM CONTAINING OXYGEN. Wechsler, M. S.; Bajaj, R. (Ames Lab., IA). Scr. Met.; 8: No. 7, 885-888(Jul 1974).

Radiation effects on strain aging of oxygen-containing V are reported. Results show that strain aging at 0.2 Tm (melting temperature in °K) is retarded by neutron irradiation. This implies that the oxygen interstitial atoms migrate to radioinduced defect clusters instead of migrating to dislocations where they would normally induce strain aging. (JRD)

24740 KINETIC THEORY FOR THE ANNEALING OF RADIATION DAMAGE IN GERMANIUM. Pritchard, W. M. (Old Dominion Univ., Norfolk, VA); Reid, J. L. Nucl. Sci. Eng.; 55: No. 1, 11-16(Sep 1974).

General solutions are presented in power series form of kinetic equations for the annealing of radiation defects in an elemental semiconductor such as germanium. A kinetic model with an arbitrary number of types of defect complexes is considered, as well as a simple model based on only one species of defect complex. For the simple model, it is shown that a single nonlinear differential equation can be derived for the fraction of defects not annealed. The first integral of this nonlinear equation is obtained for a special case. (auth)

Other Materials

Refer also to abstracts 24096, 24101, 24102, 24489, 24714, 25721, and 25835.

24741 (AD-774028/5GA) TIME AND TEMPERATURE DEPENDENCE OF BORON/EPOXY AND GRAPHITE/EPOXY LAMINATES. Technical Report, 1 July 1972–30 June 1973. Heller, R. A.; Swift, G. W.; Stinchcomb, W. W.; Thakker, A. B.; Liu, J. C. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). 9 Nov 1973. Contract F33615-72-C-2111. 76p. (AFML-TR-73-261). NTIS $4.00.

In order to develop techniques for accelerated characterization of composite materials, tests were performed on boron/epoxy and graphite/epoxy specimens. Results of vibration tests and constant strain rate tests at various temperatures are reported, together with some preliminary fatigue and damage studies. (auth)

24742 (AD-775732/1) ANALYTICAL INVESTIGATION OF STRESS CONCENTRATIONS DUE TO HOLES IN FIBER REINFORCED PLASTIC LAMINATED PLATES, TWO-DIMENSIONAL MODELS. Final Report, 15 January 1971–15 January 1972. Rybicki, E. F.; Hopper, A. T. (Battelle Columbus Labs., Ohio (USA)). Mar 1972. Contract F33615-71-C-1239. 49p. (AFML-TR-72-15). NTIS $5.50.

Results of an equilibrium finite element analysis to obtain stress distributions for anisotropic plates containing a hole are presented. Equilibrium is satisfied exactly by associating a stress function with each element. Stress function representations are such that the number of unknown coefficients per element can vary from element to element. Also the powers of the radial coordinate R in the stress function representation can be distinct for each element. The results of an investigation to determine which powers of R are most appropriate are presented. Solutions to several problems containing high stress gradients are obtained using the method. Numerical results compare very well with reference solutions. Elastic constants for other problems are selected to represent a single boron/epoxy lamina and also various symmetric boron/epoxy lay-ups. An extension of the method to the three-dimensional problem of a laminate containing a hole is described. (GRA)

24743 (AD-776068/9) THERMAL LOADING OF STRUCTURAL MATERIALS. Final Report, 26 April 1972–24 September 1973. Childers, K.; Shea, J. (Physics International Co., San Leandro, Calif. (USA)). Jan 1974. Contract F29601-72-C-0085. 78p. (AFWL-TR-73-164). NTIS $4.00.

An experimental program to obtain dynamic strain gage measurements and total impulse on 9-in. dia rings in a pulsed electron beam environment has been accomplished. A multichannel strain-gage data-acquisition system was assembled and records of strains generated by thermal and combined thermal and impulsive loading were obtained for 6061-T6 aluminum and ATJ graphite rings. The mean electron energy was on the order of 600 keV and fluences on the order of 25 cal/cm^2 were obtained. Detectable permanent deformation was produced in all samples. (auth)

24744 (AD-776262/8) ELECTRONICS OF COMPOUND SEMICONDUCTOR INTERFACES: SUMMARY OF WORKSHOP CONFERENCE HELD AT FORT COLLINS, COLO., ON FEBRUARY 5–6, 1974. Sites, J. R.; Wilmsen, C. W. (Colorado State Univ., Fort Collins (USA)). 1 Mar 1974. Contract N00014-67-A-0299-0017. 86p. (SF-2). NTIS $7.50.

Summaries are presented of the formal presentations made at the electronics of compound semiconductor interfaces workshop conference held February 5–6, 1974, at Colorado State University. The purpose of the workshop conference was to learn what progress is being made in understanding the boundaries of compound semiconductors and the significant effects these interfaces have on the operation, reliability, and stability of electronic devices. Various participants reported on the behavior of free semiconductor surfaces, semiconductor-metal, semiconductor-insulator, and semiconductor-semiconductor interfaces. For the most part the discussions dealt with compound semiconductors with particular emphasis on III to V period materials. (GRA)

24745 (AED-CONF-74-089-036) ESR AND THERMOLUMINESCENCE OF X-RAY INDUCED CENTERS IN $CaMoO_4$ MONOCRYSTALS. Biederbick, R.; Born, G.; Hofstaetter, A.; Scharmann, A. (Giessen Univ. (F. R. Germany). 1. Physikalisches Inst.). 1974. 6p. (In German). INIS.

From spring meeting of the working group solid state physics of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

6 figs.; 6 refs. With abstract.

Centers are observed in the ESR spectrum, the thermal decay of which is correlated with the glow curve of the thermoluminescence. Among others, there are holes which are trapped between $(NbO_4)^{3-}$ and $(MoO_4)^{3-}$ tetrahedrons. The thermally activated hole migration is discussed in terms of the "small polaron" model. (auth)

24746 (GA-A-12944) DEVELOPMENT STATUS OF NEAR-ISOTROPIC GRAPHITES FOR LARGE HTGRs. Engle, G. B.; Price, R. J.; Johnson, W. R.; Beavan, L. A. (General Atomic Co., San Diego, Calif. (USA)). 1 Jun 1974. Contract AT(04-3)-167. 114p. Dep. NTIS $5.45.

The physical, thermal, and mechanical properties and the irradiation behavior of the near-isotropic graphites (typically grade H-451) are compared with those of the anisotropic reference needle-coke graphite, grade H-327. Results show that near-isotropic graphites have excellent potential to fulfill all requirements of large HTGR core design; grade H-451 is equal or superior to grade H-327 in all relevant properties except thermal expansivity. The properties studied include density, thermal expansivity, thermal conductivity, tensile properties, chemical impurities, and oxidation rate. (DLC)

24747 (KF-2-73) EFFECT OF GAMMA AND NEUTRON IRRADIATION AND TEMPERATURE ON THE ELECTRICAL PROPERTIES OF PYRITE. Aladi, F.; Buget, U. (Ankara Nuklear Arastirma Merkezi (Turkey)). Apr 1973. 34p. (In Turkish). INIS.

The effects of gamma and neutron irradiation on the electrical properties of pyrite have been studied by Hall Effect. It has been observed that neutron irradiation and temperature have effects on the electrical characteristics of pyrite, but gamma has none. (INIS)

24748 (TRG-Report-2513(S)) FATIGUE, NOTCH SENSITIVITY AND WORK OF FRACTURE STUDIES ON ISOTROPIC GRAPHITE. Brocklehurst, J. E.; Brown, R. G. (UKAEA Reactor Group, Springfields). Aug 1974. 32p. Dep. NTIS (US Sales Only) $4.75. UK £1.00.

Fatigue endurance data from stress cycling tests at room temperature are presented in terms of the ratio of applied stress to the mean stress for static failure. Data from different graphites and modes of testing correlate reasonably well and the same normalised curves apply to pre-irradiated specimens and to specimens tested under a biaxial tensile stress. There is an effect of mean stress level on fatigue endurance, with a biased mean tensile stress producing less fatigue damage than zero mean stress cycles to the same peak stress (with greater stress amplitude). No weakening effect was observed on specimens strength tested after stress cycling. Fracture tests on notched specimens of graphite showed that this material is not as sensitive to notches with small root radii as theory would predict for brittle materials. A method of rationalising the data from specimens of different geometry is proposed in terms of a notch sensitivity factor, which is defined as a function of notch radius for the isotropic graphites studied, but is expected to vary with graphite type. Work of fracture measurements on different types of specimen show reasonably consistent results for all specimens except for circumferentially notched round bars which give low values. The simple technique used, based on a load criterion of failure, does not offer results which can be used confidently in general design problems but they might be applied in particular situations. Both the work of fracture and notch sensitivity tests indicates that there is a limit to the degree of sharpness that can be induced artificially by machine defects. Results are discussed in terms of inherent defect size and separation. (auth)

24749 KINETICS OF COLLOIDAL CENTER GENERATION IN ELECTRON-IRRADIATED LiF CRYSTALS. Ekmanis, Yu. A.; Chadaev, V. A.; Shvarts, K. K. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 3, 66-69(1974). (In Russian).

Kinetics of colloidal center generation in LiF crystals has been studied by electron microscopy. The metallic products yield in LiF crystals is shown to be of a multistage nature which is determined by the diffusion and separation processes in electron and hole radiolysis products. The efficiency of colloidal center generation in electron-irradiated LiF crystals is greatly dependent on irradiation temperature. (auth)

24750 CONVERSION AND ANNEALING OF COLOR CENTERS IN IRRADIATED NaCl CRYSTALS. Ozerskii, V. Ya.; Kristapson, Ya. Zh. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 3, 17-19(1974). (In Russian).

Color center annealing in NaCl crystals has been investigated after 3.5-*MeV* electron irradiation at 10^2-10^4 *Mrad doses*. Conversion of F-centers into X- and M-centers is observed at 180-200°C, whereas V-center optical absorptions changes are very small. V-center annealing occurs at 240°C simultaneously with X-center final annealing. (auth)

24751 SOLID STATE PHYSICS. Proceedings of the German Physical Society Conference Held at Muenster, Germany, Muenster, Germany, March 19-24, 1973. Abstracts of Papers. Verhandlungen der Deutschen Physikalischen Gesellschaft, Reihe VI, Band 8, 1973. Weinheim, Ger.; Physik-Verlag (1973). 303p. (In German and English). (CONF-730361-(Absts.)).

Abstracts of papers presented at the conference are compiled. The topics discussed were semiconductors, metal physics, surface physics, high polymer physics, thermodynamics, and low temperature physics. (JSR)

24752 ANNUAL MEETING ON MAGNETISM. Proceedings of the German Physical Society, Bad Nauheim, Germany, March 27-29, 1973 and Giessen, Germany, March 31, 1973. Abstracts of Papers. Verhandlungen der Deutschen Physikalischen Gesellschaft, Reihe VI, Band 8, 1973. Weinheim, Ger.; Physik-Verlag (1973). 63p. (In German and English). (CONF-730362-(Absts.)).

Abstracts of papers presented to the conference are compiled. The topics discussed include structure studies with neutrons, magnetic alloys, theory of magnetism, magnetic effects, resonance phenomena, ferrites and garnets, Moessbauer effects, permanent magnets, domain configurations and demagnetization, thin layers, and magnetostriction and magnetoelastic effects. (JSR)

24753 OBSERVATION OF BLOCKING CONTACTS AT Mo-AMORPHOUS GeSe-Mo SANDWICHES. Braun, F. (Univ., Dresden): Phys. Status Solidi (a); 23: No. 1, K99-K102(16 May 1974).

The temperature dependence of the conductance and capacitance of Mo/amorphous GeSe/Mo sandwiches was measured at different frequencies (400 Hz to 400 kHz). Results can be explained by a simple equivalent circuit, suggesting Schottky barriers. The hopping conductance is nearly temperature independent. (DLC)

24754 FRUEHJAHRSTAGUNG BRAUNSCHWEIG 1974 DER ARBEITSGEMEINSCHAFT MAGNETISMUS, VOM 26. BIS 28. MAERZ 1974 IN BRAUNSCHWEIG. (Conference on Magnetism, Brunswick, Germany, March 26-28, 1974. Abstracts of Papers). Weinheim, Ger.; Physik Verlag GmbH (1974). 43p. (CONF-740323-(Abst.)).

Abstracts of the papers presented at the conference are compiled. The topics discussed include nuclear resonance, antiferromagnetism, Moessbauer effect, earth's magnetism, magnetic semiconductors, magnetoelastic effects, permanent magnets, phase transitions, studies using neutrons, domain structure, demagnetization, weak ferromagnetics, and theory. (JSR)

24755 THE STATE OF FERRITES EXPOSED TO HIGH-ENERGY IRRADIATION. Dersch, W. (Siemens A. G., Muenchen (F. R. Germany). Unternehmensbereich Bauelemente). Siemens-Z.; 48: No. 2, 114-116(Feb 1974). (In German).

2 figs.; 2 tabs.; 3 refs.

In an experiment simulating the conditions in the Van-Allen belt, Siferrit ring cores (Mn-Zn-ferrite) were exposed to reactor irradiation corresponding to an energy dose of 5×10^8 cJ/kg (5×10^8 rad) in the center of the inner Van Allen belt. Measurements of the sample properties of interest with regard to future applications of the material show that components with a ferrite core are highly radiation-resistant. (CB)

24756 GRAPHITE THERMAL EXPANSION REFERENCE FOR HIGH TEMPERATURE. Gaal, P. S. (Westinghouse Electric Corp., Pittsburgh). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 17, 102-116(1974).

From international symposium on thermal expansion of solids; Lake of the Ozarks, Missouri, USA (7 Nov 1973). See CONF-731118-.

The design requirements of the aerospace and high temperature nuclear reactor industries necessitate reliable thermal expansion data for graphite and other carbonaceous materials. Currently there are no accepted standards or reference materials which can be used in carbon-rich atmospheres at temperatures ranging to 2500°C. The feasibility of an acceptable reference for calibration of expansion measuring systems that operate in such test environments (furnaces utilizing graphite heaters, for example) is the prime subject of this work. Present-day graphite technology provides acceptable materials for stable, reproducible references, as reflected by some of the candidate materials. The repeatability for a single specimen in a given expansion measuring system was found to be ±1%, while the combined results of several tests made on a number of samples fell within a ±2.5% band. Data on several grades of candidate graphites are discussed, and results of a broad round robin program presented. (auth)

24757 MICROSTRUCTURAL ASPECTS OF THERMAL EXPANSION IN GRAPHITES. Hollenberg, G. W.; Ruh, R. (Air Force Materials Lab., Wright-Patterson AFB, OH). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 17, 241-255(1974).

From international symposium on thermal expansion of solids; Lake of the Ozarks, Missouri, USA (7 Nov 1973). See CONF-731118-.

An investigation was conducted to determine the cause of wide variations (factor of 5) observed in the bulk thermal expansion of the polycrystalline graphites: ATJ-S, AXF-5Q, mesophase and isostatically pressed. An attempt to rationalize this spectrum on the basis of lattice thermal expansion was unsuccessful because of the relatively small differences in that lattice expansion. Addition of boron to the isostatically pressed graphite reduced the thermal expansion in the c-direction by approximately 30%. The low thermal expansion coefficient of ATJ-S as compared with that of AXF-5Q and the mesophase-based graphite can be explained by the existence of microcracks between the layer planes in the ATJ-S filler particles. In the AXF-5Q and mesophase-based graphites, very little microcracking could be distinguished. The qualitative theory of Mrozowski and the more quantitative model of Buessem were examined. It was found that the results are essentially in agreement with Buessem's model. The isostatically pressed material must possess significant tessellated stresses or distortion in order to explain the very high bulk expansion. (auth)

24758 STUDY OF THE CRYSTALLIZATION OF BOROSILICATE GLASSES INTENDED FOR THE FIXATION OF HIGH-ACTIVITY FISSION PRODUCT OXIDES. Heimerl, W. Berlin, Ger.; Technische Univ. (1972). 110p. (In German). INIS.

50 figs.; 12 tabs.; 47 refs. with abstract. Available from the TU Berlin library.

The crystallization behavior of borosilicate glasses with varying

contents in Na_2CO_3, B_2O_3 and Al_2O_3 were studied with the goal of testing their suitability for the fixation of highly active fission product wastes. The temperature of the maximum crystallization rate was measured by differential thermal analysis, type and amount of crystallization product was determined by X-ray diffraction. In some glasses as well as in their crystallization products the self-diffusion coefficient of Na was measured using the ^{24}Na-heterogeneous isotope exchange method. In general, uniform diffusion coefficients were obtained which could be coordinated to a volume diffusion (with the only exception of a crystallized glass with a very low boron content). Moreover, some glasses with high alkalioxide content as well as their crystallization products were subjected to water leach tests and the leached amounts of Si, B, and Na were determined as a function of time. The mechanism of leaching is discussed. The leached amounts are remarkably higher in the case of crystallized products. As a result of the experiments, the better suitability of the glasses poor in alkali oxides for high-activity waste fixation is emphasized. (GE)

24759 LUMINESCENCE AND OPTICALLY DETECTED EPR OF CLOSE F-CENTER PAIRS IN KCl. Schnegg, P. A.; Jaccard, C.; Aegerter, M. (Univ. Neuchatel, Switzerland). Phys. Status Solidi (b); 63: No. 2, 587-598(1 Jun 1974).

By an appropriate optical treatment at room temperature the distance separating the members of F-center pairs can be decreased, giving rise to different optical and magnetic properties, revealed by the existence of a spin dependent non-radiative disexcitation mechanism. A model with an exchange spin–spin interaction is analyzed and compared with experiments at liquid helium temperature (variation of the luminescence with an applied magnetic field, optical detection of the EPR, and relaxation processes). The observed effects are related with population changes in the ground state caused by optical pumping and they are sensitive to the mixing of the states produced by the different interactions. The average exchange energy is found to range between the hyperfine and the Zeeman energy depending on the state of aggregation. The paramagnetic resonance occurs in the ground state (g = 1.998, linewidth 52 G) and the relaxation times range between 25 and 250 ms, depending on the optical pumping rate. The relation predicted by the model between the luminescence variation and the relaxation rate agrees with the experiments. (auth)

24760 HARDENING AND ACTIVATION VOLUME IN γ-IRRADIATED KBr : Li. Fujiwara, M.; Tanimura, K.; Okada, T.; Suita, T. (Osaka Univ., Suita, Japan). Phys. Status Solidi (b); 63: No. 2, K111-K114(1 Jun 1974).

Correlations among the radiation-induced flow stress, the activation volume, and behavior of interstitial type defects in the formation and thermal annealing process of irradiated KBr : Li monocrystals is reported. Results show that V(306) centers play a different role from that of H_A(Li) and/or I_A(Li) in interactions with the dislocations, though details remain unsolved. (JRD)

24761 STRUCTURE INVESTIGATION OF ZnTe AND CdTe CRYSTALS BY TRANSMISSION MICROSCOPY. Liliental, Z. (Inst. of Physics, Warsaw); Mizera, E.; Bartsch, H. Phys. Status Solidi (a); 23: No. 2, K115-K121(16 Jun 1974).

P-type ZnTe and CdTe crystals were grown from melted solutions containing excess Te. The materials investigated were sphalerite structure. The characteristics of the dislocation structures are shown in micrographs. (JRD)

24762 RADIOLYSIS OF ALKALINE EARTH FLUORIDES. Hayes, W. (Oxford Univ.). J. Phys. (Paris), Colloq.; No. 9, 499-502(1973).

From first international conference on lattice defects in ionic crystals; Marseilles, France (2 Jul 1973).

The structures of color centers in alkaline earth fluorides are now sufficiently well known to make studies of mechanisms of radiolysis possible. This short review describes results of recent measurements on the temperature dependence of the efficiency of F-center production in CaF_2 and SrF_2 and discusses primary processes of defect production. (FR)

24763 TRAPPING OF MOBILE INTERSTITIALS DURING IRRADIATION OF ALKALI HALIDES. Sonder, E. (Oak Ridge National Lab., TN). J. Phys. (Paris), Colloq.; No. 9, 483-487(1973).

From first international conference on lattice defects in ionic crystals; Marseilles, France (2 Jul 1973).

For many alkali metal halides, there exists a rather large temperature range in which radiation-produced anion interstitials are quite mobile whereas the accompanying vacancies are not. For these conditions, it is possible to derive simple rate equations for the production rate of stable vacancies (F centers) and the disappearance rate of previously introduced divacancies (F_2 centers). Comparison of the predictions of these equations with experimental results for KCl has yielded values for the primary F-center production efficiency for the temperature range 80–250°K from which a number of conclusions have been drawn: a) The previously observed increase in F-center production rate due to impurity at 80°K is due to increased interstitial trapping. b) The increase with temperature of the F-center production rate between 120 and 240°K is due to an intrinsic increase in the primary F-center production efficiency. c) The absolute value of the primary F-center production efficiency at 240°K is greater than .01 eV^{-1} which is possible only if radiation defect production proceeds by a single ionization mechanism. (FR)

24764 CREATION OF COLOR CENTERS BY IONIZING RADIATION IN ALKALI HALIDES. Farge, Y. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 9, 475-482(1973).

From first international conference on lattice defects in ionic crystals; Marseilles, France (2 Jul 1973).

In the first part of this review paper, secondary processes in the formation of F centers are discussed: recombination of interstitials, V_K centers, and vacancies between themselves, decreasing the number of apparent F centers. In the second part, recent results on the primary process are exposed: why an excitonic recombination forms an F-H center pair, why the H center is ejected far enough to have only a small probability to recombine with its associate vacancy. In the last part, the formation mechanism of F aggregate centers is discussed. (FR)

24765 COLOR CENTERS DUE TO CATIONIC DEFECTS CREATED BY HIGH ENERGY IONS IN LiF AND KCl. Thevenard, P.; Perez, A.; Davenas, J.; Dupuy, C. H. S. (Univ., Lyon). J. Phys. (Paris), Colloq.; No. 9, 289-293(1973). (In French).

From first international conference on lattice defects in ionic crystals; Marseilles, France (2 Jul 1973).

The creation and the evolution of charged centers in LiF and KCl bombarded with high-energy particles exhibit some recombination mechanism different from those observed in crystals irradiated with ionizing radiations. This can be explained by the presence of cationic defects trapping the electrons. The aggregation of the cationic defects by thermal annealings shows the presence of alkali metal colloids associated with halogen bubbles. The position and the evolution of those aggregate center absorption bands induce us to consider the possibility of metallic hydrogen. This hypothesis seems verified in the case of LiF bombarded with protons. (FR)

24766 TRANSMISSION ELECTRON MICROSCOPY OF DEFECTS IN ALKALI HALIDES. Hobbs, L. W. (Oxford Univ.). J. Phys. (Paris), Colloq.; No. 9, 227-241(1973).

From first international conference on lattice defects in ionic crystals; Marseilles, France (2 Jul 1973).

Difficulties encountered in conventional thin-foil electron microscopy of alkali metal halides are considered and it is demonstrated how each can, within certain limits, be successfully overcome. Measurements include careful thin-foil specimen preparation and examination at liquid helium temperature. In particular, low-temperature microscopy is shown to significantly retard the onset of observable radiation damage effects induced by the investigating electron beam. A brief account of the application of these techniques to studies of irradiation defect aggregations and dislocation behavior in irradiated and deformed alkali metal halide crystals is presented. (FR)

24767 LOW-TEMPERATURE PLASTIC DEFORMATION OF IRRADIATED LiF. Cagnon, M. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 9, 217-225(1973). (In French).

From first international conference on lattice defects in ionic crystals; Marseilles, France (2 Jul 1973).

Results are presented for the plastic properties of LiF single crystals, irradiated with γ rays at liquid nitrogen and room temperatures. Mechanical tests were performed between 4 and 400°K: temperature dependence of the flow stress, activation volume, and activation energy are discussed in terms of the thermally activated deformation theory. It is shown that the halogen interstitials, created together with color centers by ionizing radiation, are divided in two groups: some of them are trapped by positive divalent impurities to form a defect responsible for the thermal part of the flow stress by elastic interaction with moving dislocations (their number does not depend on radiation dose after the first stage of irradiation); the others coalesce in small interstitial loops responsible for the high athermal flow stress by a mechanism of junction with moving dislocations (the number of these loops is rather constant but their size increases with radiation dose). (FR)

24768 RARE GAS ATOMS IN IONIC CRYSTALS: METHODS, RESULTS, AND APPLICATION TO THE STUDY OF LATTICE DEFECTS. Felix, F. W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). J. Phys. (Paris), Colloq.; No. 9, 149-157(1973).

From first international conference on lattice defects in ionic crystals; Marseilles, France (2 Jul 1973).

In the last ten years, the atomic transport of Ar, Kr, and Xe in

simple cubic ionic crystals (alkali metal halides of NaCl- and CsCl-structure, and alkaline earth fluorides of CaF_2-structure) has been studied thoroughly. This paper gives a survey of the hitherto published literature, with emphasis on the work on the introduction of rare gas atoms by transformation of lattice components with nuclear reactions. The two main features of these investigations are that the gas atoms are mobile in most cases as interstitials and that they react with lattice defects. Such defects may be e.g. thermally or chemically introduced cation vacancies and radiation-induced defects. The experimental technique to determine the gas mobility with the help of radioactive tracers is briefly described. The main experimental results are summarized and compared with the calculations of Norgett and Lidiard. (FR)

24769 ROLE OF INTERSTITIAL CLUSTERS IN THE FORMATION OF FRENKEL DEFECTS IN ALKALI HALIDES. Guillot, G. (INSA, Villeurbanne, France); Pinard, P.; Hermann, F. J. Phys. (Paris), Colloq.; No. 9, 113-116(1973). (In French).

From first international conference on lattice defects in ionic crystals; Marseilles, France (2 Jul 1973).

The F center concentration in KBr and KCl grows under electron irradiation at LNT as $t^{0.75}$ in pure and as $t^{0.5}$ in doped or impure crystals. These findings, with a model in which the growth rate is determined by interstitial stabilization, results in the following conclusions: 1) The interstitial capture probability by a trap varies with the trap size in the pure crystals; 2) The capture probability is independent of the trap size in the impure samples. This can be explained by a long-range interaction between traps and interstitials. (FR)

24770 RADIATION-INDUCED DYNAMIC MOTION OF INTERSTITIAL HALOGEN IN ALKALI HALIDES. Itoh, N.; Saidoh, M. (Nagoya Univ., Japan). J. Phys. (Paris), Colloq.; No. 9, 101-105 (1973).

From first international conference on lattice defects in ionic crystals; Marseilles, France (2 Jul 1973).

Recent experiments on the dynamic motion of the interstitial halogen induced by ionizing collisions in alkali metal halides are reviewed. In view of the experimental results of the temperature dependence of the interaction volume of the interstitial halogen with defects, it is suggested that a replacement sequence of the interstitial halogen has a hole in a p-orbital perpendicular to the direction of motion. A new model of the F center formation is also suggested. (FR)

24771 LATTICE DEFECTS IN IONIC CRYSTALS. Lidiard, A. B. (United Kingdom Atomic Energy Research Authority, Harwell, Eng.). J. Phys. (Paris), Colloq.; No. 9, 1-2(1973).

From first international conference on lattice defects in ionic crystals; Marseilles, France (2 Jul 1973).

The review covers (i) defect states, structures and energies, (ii) point defects in or near thermodynamic equilibrium, and (iii) the production of defects by irradiation and radiation damage phenomena. Attention is particularly drawn to new experimental and theoretical techniques and their implications (for example, low-temperature electron microscopy and nanosecond-pulse irradiations on the experimental side, vibronic models of color centers and computer simulations of defects on the theoretical side). The growing knowledge of defect structure and defect production which these, and more established, techniques give is likely rapidly to advance the understanding of more complex processes (e.g. irradiation hardening, diffusion in more highly defective solids, etc.). (FR)

24772 RADIATION DEFECT AND 3rd IMPURITY ABSORPTION IN MgF_2 AND $KMgF_3$ CRYSTALS. Sibley, W. A.; Yun, S. I.; Feuerhelm, L. N. (Oklahoma State Univ., Stillwater). J. Phys. (Paris), Colloq.; No. 9, 503-506(1973).

From first international conference on lattice defects in ionic crystals; Marseilles, France (2 Jul 1973).

In both MgF_2 and $KMgF_3$, Mg^{2+} has approximately octahedral site symmetry. When 3d ions are substituted for Mg^{2+} ions, their optical transitions are governed by their spin states and symmetry. Since many transitions are both spin and symmetry forbidden, the oscillator strengths are extremely low (10^{-7}). This is a severe limitation for most investigations and requires that long crystals be used. When samples are irradiated with electrons, F centers are produced which migrate to the impurity sites and are trapped. Such a process lifts the symmetry forbiddenness of the transitions and at the same time couples the F center wave functions with the impurity wave functions to lift the spin forbiddenness. Changes in oscillator strength of 10^3-10^5 can be observed for certain transitions. Our studies indicate that symmetry forbiddenness is a very weak selection rule. The increased absorption due to irradiation allows tentative assignments to be made for the various optical transitions of the 3d impurity ion-F center complexes. In addition, mention is made of how these impurities affect the production of stable radiation damage defects and how the optical transitions can be used to probe for the location of radiation-induced interstitials. (FR)

24773 ANOMALIES OF THE SPECIFIC HEAT AND MAGNETIC THERMODYNAMIC PARAMETERS OF YTTRIUM ORTHOVANADITE. Borukhovich, A.S.; Bazuev, G.V.; Shveikin, G.P. (Institute of Chemistry, Ural Scientific Center, Academy of Sciences of the USSR, Sverdlovsk). Sov. Phys.-Solid State 16: No. 1, 191-192 (July 1974).

The enthalpy and entropy of the magnetic phase transition and the magnitudes of the lattice and magnetic specific heat components are deduced from measurements of the temperature dependence of the specific heat of YVO_3. (AIP)

24774 NUCLEAR MAGNETIC RESONANCE OF V^{51} IN RARE-EARTH ORTHOVANADATES. Pletnev, R.N.; Lisson, V.N.; Gubanov, V.A.; Chirkov, A.K. (Institute of Chemistry, Ural Scientific Center, Academy of Sciences of the USSR, Sverdlovsk). Sov. Phys.-Solid State 16: No. 1, 193-194 (July 1974).

Nuclear magnetic resonance spectra of V^{51} have been measured at room temperature in polycrystalline samples of RVO_4 where R = Pr, Nd, Sm, En, Lu. (AIP)

24775 MAGNETIC PROPERTIES OF RARE-EARTH ORTHOVANADITES. Bazuev, G.V.; Matveenko, I.I.; Shveikin, G.P. (Institute of Chemistry, Ural Scientific Center, Academy of Sciences of the USSR, Sverdlovsk). Sov. Phys.-Solid State 16: No. 1, 155-156 (July 1974).

Lattice parameteres and molar magnetic susceptibilities have been experimentally determined for $PrVO_3$, $SmVO_3$, $GdVO_3$, $TbVO_3$, $DyVO_3$, $HoVO_3$, $ErVO_3$, $TmVO_3$, $YbVO_3$, and $LuVO_3$. (AIP) (auth)

24776 LOW-TEMPERATURE SPIN-LATTICE RELAXATION OF PROTONS IN YTTRIUM-CERIUM-HYDROGEN COMPOUNDS. Khodosov, E.F.; Prokopenko, V.K.; Linnik, A.I. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR). Sov. Phys.-Solid State 16: No. 1, 157-158 (July 1974).

Information on the electron contribution to the spin-lattice relaxation time in yttrium-cerium-hydrogen compounds was obtained from proton spin-lattice relaxation measurements at temperatures ~1-400°K and at ~ 21 Mhz. (AIP)

24777 SCATTERING OF LIGHT BY ACOUSTIC WAVES IN GADOLINIUM MOLYBDATE CRYSTALS. Esayan, S.K.; Bagdasarov, K.S.; Lemanov, V.V.; Polkhovskaya, T.M.; Shuvalov, L.A. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.-Solid State 16: No. 1, 85-89 (July 1974).

A study is made of the scattering of light by acoustic waves with frequencies 400-1200 MHz in multidomain and single-domain crystals of gadolinium molybdate. The geometry of scattering with rotation of the plane of polarization of the scattered light is analyzed. The photoelastic constants are determined and the acoustic wave velocity and damping measured. The damping of certain wave modes is found to increase sharply, which is explained by the interaction of these modes with the domain walls. It is shown that when light is scattered in multidomain samples the number of components in the spectrum of the scattered light may in general be doubled. (auth)

24778 WEAR RESISTANT COATINGS FOR REACTOR COMPONENTS IN LIQUID SODIUM ENVIRONMENTS. Johnson, R.N. (Westinghouse Hanford Company, Richland, Washington 99352); Schrock, S.L.; Whitlow, G.A. J. Vac. Sci. Technol. 11: No. 4, 759-764 (July 1974).

Rubbing surfaces of critical components for the coming generation of the nation's liquid-metal-cooled fast-breeder reactors must withstand severe environments of high temperature, liquid-metal corrosion, and nuclear irradiation. For some component requirements, the use of the better known bearing materials and hardfacings has been shown to be inadequate or impractical. For several applications, bulk (>25-μ thick) coatings have provided the only successful solution to friction problems in high-temperature sodium. Coating processes that have been or are being evaluated include plasma spray, detonation gun, spark-discharge, sputtering, and diffusion coating processes. Testing included friction and wear tests in up to 650°C sodium, sodium corrosion tests for up to one year, thermal cycling, bond strength tests, and irradiation tests in a fast reactor. For one particularly severe application, a specially modified commercial coating of chromium carbide in a 15 vol% nichrome binder, applied by a commercial detonation gun process, has so far been found to be most acceptable in meeting the friction, corrosion, and irradiation damage criteria. Much of the test data reported is on this coating and its antecedent modifications. (auth)

24779 DISLOCATION MOTION IN γ IRRADIATED NaCl AND KCl CRYSTALS. Novikov, N.N.; Makara, V.A. (Kiev University). Sov. Phys.-Crystallogr. 19: No. 1, 108-109 (July 1974).

It is shown that γ-irradiation of NaCl and KCl crystals causes changes in lattice resistance to dislocation motion as reflected by internal stress peak variations. Such changes produce corresponding

macroscopic changes in mechanical characteristics of the alkali halide crystals after irradiation. (AIP).

24780 TRAP DENSITY DETERMINATION IN CdS THIN FILMS BY SPACE CHARGE LIMITED CURRENTS. Aladli, F.; Turek, D. (Ankara Nuclear Research Center). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 1, 27-31(Feb 1974).

In CdS thin films, the trap densities were calculated by J–V curves. The J–V curves displayed three different regions: (1) ohmic region ($J \sim V$), (2) exponential region ($J \sim e^{aV}$), (3) square law region ($J \sim V^2$). In order to calculate the trap densities, Rose's theory has been used. The trap densities were in the order of 10^{14} to 10^{15} $eV^{-1} \cdot cm^{-3}$, and the activation energy of the traps was found to be $E_A = 0.51$ eV. (auth)

24781 TRAP DEPTH MEASUREMENTS BY THERMOLUMINESCENCE IN $Li_2B_4O_7$ CRYSTALS. Serin, N.; Erdogmus, M. (Ankara Nuclear Research Center). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 1, 33-38(Feb 1974).

The energy of traps was determined in $Li_2B_4O_7$ (% 01 Mn) crystals using three different methods of thermoluminescence and found to be $E_1 = 1.17$ eV by different heating rate method, $E_2 = 0.93$ eV by post-irradiation annealing method, and $E_3 = 0.96$ eV by glow curve method. The corresponding frequency factors were $s_1 = 2.18 \times 10^{13}$ s^{-1}, $s_2 = 2.03 \times 10^{8}$ s^{-1} and $s_3 = 9.00 \times 10^{8}$ s^{-1}. (6 fig) (auth)

24782 PULSE CHANGE OF POLARIZATION IN SINGLE CRYSTALS OF DEUTERATED TRIGLYCINESELENATE. Varykash, V. M.; Pupkevich, P. A.; Zarembovskaya, T. A. (Minsk Radiotechnical Inst.). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 2, 106-110(1974). (In Russian).

The pulse change in polarization of single crystals of partially deuterated triglycineselenate was studied. Results are compared with analogous measurements for a simple crystal. (SJR)

24783 EFFECTS OF X-RAY RADIATION TO THE SURFACE-STATE DENSITY IN A MEAL-OXIDE-SEMICONDUCTOR STRUCTURE. Elliatioglu, M. R.; Sencer, O. (Ankara Nuclear Research Center). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 1, 23-25 (Feb 1974).

A 2160-Å thick SiO_2 layer was grown on a p-type silicon wafer of resistivity 5 ohm-cm and an $Au/SiO_2/Si/Al$ MOS structure was built. The C–V characteristics of the structure were measured at 4.5 MHz, and the surface-state density was calculated to be about 1.4×10^{11} cm^{-2}. Change in the surface-state density with x-ray irradiation was investigated. (auth)

24784 PRESSURE AND TEMPERATURE DEPENDENCES OF THE ELASTIC CONSTANTS OF COMPRESSION-ANNEALED PYROLYTIC GRAPHITE. Gauster, W.B.; Fritz, I.J. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 45: No. 8, 3309-3314 (Aug 1974).

Changes of ultrasonic transit times in compression-annealed pyrolytic graphite (CAPG) were measured as a function of temperature (4–300 °K at atmospheric pressure) and of pressure (0–20 kbar at 295 °K). From the low-temperature results, obtained for five independent acoustic modes, the temperature variations of all five elastic constants were calculated using the thermal expansion data of Bailey and Yates. From the high-pressure data, taken for four independent modes, the changes of all five elastic constants and of the unit cell dimensions with pressure were calculated under the assumption that the small a-axis compressibility is independent of pressure. The initial pressure derivatives of C_{33} and C_{44} are, respectively, about 25 and 35% lower than those obtained by Green et al. for CAPG. The pressure dependences of the volume and c-axis compressibilities are in good agreement with measurements on natural graphite crystals by Lynch and Drickamer and by Bridgman, and in less satisfactory agreement with data of Kabalkina and Vereshchagin. The results support the contention that CAPG has bulk elastic properties very similar to those of single-crystalline graphite. (auth)

24785 NUCLEAR MAGNETIC RELAXATION IN SOME IRRADIATED POLYMERS. Draghicescu, P.; Grosescu, R. (Institutul de Fizica Atomica, Bucharest (Romania)). pp 222-224 of Magnetic Resonance and Related Phenomena. Hovi, V. (ed.). Amsterdam; North-Holland Publishing Company (1973).

From 17th Congress AMPERE on magnetic resonance and related phenomena; Turku, Finland (21 Aug 1972).

Spin-lattice relaxation-time measurements were made on protons in some irradiated and unirradiated polymers. Measurements were performed with a NMR pulsed spectrometer "Brucker", type B-KR 322, using a sequence to cancel the magnetization and an inspection $\frac{1}{2}\pi$ pulse. Samples of commercially available polymethylmethacrylate, low-density polyethylene and polycarbonate, in pieces of a few mm^3 were irradiated in liquid nitrogen with 3-MeV electrons at a dose 600 Mrad/h. During the irradiation paramagnetic centers are formed and the proton-spin-lattice relaxation time T_{1n} of the polymer should decrease. However for low doses of irradiation (~10 Mrad) an increase of this time is obtained. (auth)

24786 ESR AND MICROWAVE DIELECTRIC MEASUREMENTS OF γ-IRRADIATED FERROELECTRIC AMMONIUM HYDROGEN SULFATE. Barbur, I.; Bodi, A.; Popescu, G. D.; Militaru, V. (Cluj Univ. (Romania)). pp 199-201 of Magnetic Resonance and Related Phenomena. Hovi, V. (ed.). Amsterdam; North-Holland Publishing Company (1973).

From 17th Congress AMPERE on magnetic resonance and related phenomena; Turku, Finland (21 Aug 1972).

It was reported that the ammonium hydrogen sulfate, $(NH_4)_2SO_4$, is ferroelectric in the temperature range between –3°C and –119°C. In a previous paper ESR measurements showed that under gamma irradiation of this compound two paramagnetic species appear: SO_4^- and $HNSO_3$-ionic radicals. Further information concerning the transition point at –3°C is obtained by ESR and dielectric constant measurements at variable temperature, both performed on irradiated samples. (auth)

24787 VAPOR PRESSURES OF ISOTOPIC CARBON DIOXIDES. Bilkadi, Z. Rochester, NY; University of Rochester (1974). 114p. University Microfilms Order No. 74-14,382.

Thesis (Ph. D.).

In part I of this thesis the vapor pressures of the isotopic carbon dioxides $^{12}C^{16}O^{16}O$, $^{13}C^{16}O^{16}O$, and $^{12}C^{18}O^{18}O$ were intercompared in the temperature range 155 to 217°K. The reduced partition function ratios were calculated from the observed ratios of the vapor pressures, and correlated to the external and internal motions in the crystal. The observed vapor pressure ratios were successfully analyzed by harmonic cell model calculations assuming no coupling between the external motions among themselves and no internal-external interactions. The anharmonicities in the librational and translational oscillations were evaluated empirically from spectroscopic literature on the molecular librations in the solid, and from vapor pressure measurements on argon. In part II of this thesis the effect of translation–rotation interaction on the ratio of vapor pressures of $^{12}C^{16}O^{18}O$ and $^{12}C^{16}O^{18}O$ was derived by calculating the mean square torque and mean square force on the molecule. The mean square force and torque were readily deduced from the vapor pressure observations in part I of this work. The effect of translation–rotation interaction in the unsymmetric carbon dioxide molecule was found to be relatively insignificant. (Diss. Abstr. Int., B)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 23553, 23559, 23674, 23740, and 23742.

24788 (BNL-50414) GUIDELINES FOR GAMMA-RAY SPECTROSCOPY MEASUREMENTS OF ^{235}U ENRICHMENT. Kull, L. A.; Ginaven, R. O. (Brookhaven National Lab., Upton, N. Y. (USA)). Mar 1974. 54p. Dep. NTIS $5.45.

The alpha decay of ^{235}U to ^{231}Th is accompanied by the emission of a prominent gamma ray at 185.7 keV (4.3×10^4 of these 185.7 keV gamma rays are emitted per second per gram of ^{235}U). Due to the relatively low energy of these gamma-rays, those generated within a sample of modest size are strongly attenuated before reaching the surface so that the gamma-ray flux emitted by a thick sample approximates that of an infinitely thick medium. The 185.7 keV activity from a semi-infinite thick sample of uranium bearing material is directly proportional to the ^{235}U enrichment and, under certain circumstances, is approximately independent of the material composition. A measurement of this 185.7 keV activity with a suitable detector therefore forms the basis for an enrichment measurement technique. It is intended that this guideline provide a convenient description of the enrichment measurement technique, for determining the general applicability of the technique to a given sample or class of samples, and for estimating the level of measurement accuracy obtainable for a given set of sample characteristics. The guideline also includes an introduction to the instrumentation required for these measurements, and, it is hoped, will provide some aid in the specification of key instrumentation characteristics. (TFD)

24789 (IAEA-R-1143-F) FEASIBILITY STUDY OF DETERMINING THE CONTENT OF THE INPUT ACCOUNTABILITY VESSEL AND THE PLUTONIUM PRODUCT ACCOUNTABILITY VESSEL BY A WEIGHING TECHNIQUE. Final Report, 1 April 1972–31 March 1973. Nakajima, K. (International Atomic Energy Agency, Vienna (Austria)). Oct 1972. 64p. INIS.

The results of a study to determine the feasibility of measuring the content of an input accountability vessel and a plutonium product accountability vessel (in a fuel processing facility) by a weighing technique are reported. The approach taken was to define the "spring constant" of piping attached to the vessels to be measured and to correlate this constraint with the relative sensitivity of industrially available high precision load cells which were subjected to cyclic loading in the tare-gross capacity range of the subject vessels. In addition, consideration was given to the effect of radiation (gamma and neutron) in the environment of a commercial fuel processing facility. It is concluded that a strain gage type load cell with electronic data processing is capable of performing the desired measurement function within acceptable limits of error; however, the complete set of variables (in terms of operating condition) affecting the uncertainty of the measurement has not been reported. (INIS)

24790 (LA–5692-MS) ASSAY OF THE URANIUM CONTENT OF ROVER SCRAP WITH THE RANDOM SOURCE INTERROGATION SYSTEM. Foley, J. E.; Cowder, L. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1974. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

A neutron interrogation instrument has been built that determines the uranium content of 10-liter containers of scrap material from the Rover nuclear rocket program. The instrument determines uranium content by producing fissions in the sample, and then detecting these fissions by coincidence counting the prompt-fission neutrons and gamma rays. A measurement procedure has been developed that gives assays that are relatively independent of the matrix material in the sample. A normalization procedure has also been developed that eliminates the effects of instrumentation drifts. (auth)

24791 (RFP-1528) CONTROL DESIGN FOR PLUTONIUM COUNTING SYSTEMS. Doher, L. W.; McBride, J. D. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). [nd]. 20p. (CONF-700541-3). Dep. NTIS $4.00.

From 11th annual meeting of the Institute of Nuclear Materials Management; Gatlinburg, Tennessee, USA (25 May 1970).

A design which assures control of the plutonium counting systems used at the Rocky Flats Plant to measure solid plutonium in waste and process materials is described. Measurement bias and variability information are given for process control and inventory management. (auth)

24792 (RFP–2216) INCINERATION PROCESS FIRE AND EXPLOSION PROTECTION. Ziegler, D. L. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). [nd]. 13p. Dep. NTIS $4.00.

Two incinerators will be installed in the plutonium recovery facility under construction at the Rocky Flats Plant. The fire and explosion protection features designed into the incineration facility are discussed as well as the nuclear safety and radioactive material containment features. Even though the incinerator system will be tied into an emergency power generation system, a potential hazard is associated with a 60-second delay in obtaining emergency power from a gas turbine driven generator. This hazard is eliminated by the use of steam jet ejectors to provide normal gas flow through the incinerator system during the 60-second power interruption. The primary safety concern with an incineration process is the potential of explosion due to accumulation of flammable vapors. A second area of concern is the possibility of fire, primarily in the feed preparation and feed mechanism for the incinerator. (auth)

24793 LIKE THE DOWNFALL OF A TREE. McPhee, J. Spiegel.; 28: No. 4, 120-121 (Jan 1974). (In German).

4 figs.

For a study on the hazards of atomic extortion the physicist T. B. Taylor visited nuclear power plants and the civil nuclear industry in the U. S. A. In the present paper a journalist who accompanied him reports on the gained experiences. (GE)

24794 THE INTERNATIONAL COMPARATIVE EXPERIMENT "IDA-72" WITHIN THE FRAMEWORK OF THE NUCLEAR SAFEGUARDS PROJECT. Beyrich, W.; Drosselmeyer, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). KFK Nachr.; 6: No. 1, 34-37 (1974). (In German).

3 figs.

Description of a so called "Interlaboratory test", in which samples of the same kind are analyzed by the same methods from a group of laboratories is given. The results obtained are evaluated by statistical methods. Thus it is possible to determine not only the total error of the analytical method applied but also the importance of different error components which are associated with different steps in the analytical procedure. (GE)

Disposal and Storage

Refer also to abstracts 23724, 23729, 23747, 23748, 23975, and 24000.

24795 (ARH-1337) STUDY SALT CAKE REMOVAL FROM 241 AREA WASTE TANKS. Lee, H. A. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 30 Jul 1969. Contract AT(45-1)-2130. 27p. Dep. NTIS $4.50.

National policy in years to come is expected to call for cleaning up the air, the waters and soils of the nation. This may include cleaning the Hanford site. The greatest concentration of potential radioactive contamination by far will be the solidified contents of the 241 Area waste tanks. This study describes systems for the removal and packaging for shipment of the contents of these tanks to off-site burial facilities. (TFD)

24796 (ARH-2888(Rev.)) RETRIEVABLE SURFACE STORAGE FACILITY ALTERNATIVE CONCEPTS ENGINEERING STUDIES. (Atlantic Richfield Hanford Co., Richland, Wash. (USA); Kaiser Engineers, Oakland, Calif. (USA)). Jul 1974. Contract AT(45-1)-2130. 287p. Dep. NTIS $7.60.

The Atlantic Richfield Hanford Company is performing engineering studies under the Atomic Energy Commission's direction that will lead to the construction of a Retrievable Surface Storage Facility (RSSF), capable of receiving all high-level radioactive wastes generated by the commercial reactor fuel reprocessing plants through the year 2000 and storing these wastes under continued surveillance and maintenance. A period of 100 years is used as a design basis. The RSSF is assumed to be capable of receiving and storing approximately 75,000 canisters (1 ft dia by 10 ft long) of dry solid waste containing a total of about 200 megawatts of heat. The functional requirements for the RSSF are the storage of these wastes in a safe manner that will (1) protect the health and safety of the public, and (2) have minimum adverse impact on man's environment. General design criteria have been developed and three basic storage concepts studied to provide a basis for choosing a preferred concept for the RSSF. These concepts studied are (1) storage in water basins where the decay heat is rejected to the atmosphere by

the use of circulating cooling water, heat exchangers, and cooling towers, (2) storage in air-cooled vaults where the heat removal is by natural convection, and (3) storage in rugged, thick-wall casks placed outdoors and cooled by convective air flow. (auth)

24797 (ARH-2939(Rev.)) WORK PLAN FOR P-11 FACILITY CLEANUP. Anderson, K. J. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 3 May 1974. Contract AT(45-1)-2130. 17p. Dep. NTIS $4.00.

The work plan for the P-11 Facility cleanup to be accomplished during fiscal years (FY) 1974 and 1975 at costs of $210,000 and $420,000, respectively, is outlined. The work plan discusses the exact nature of the work involved, who will do this work, when the job will be done, and the estimated costs. The objective of the proposed work is to clean up the P-11 site and restore the area so that it will not pose an environmental hazard to people or animals and will allow alternative uses of the land area, if so desired. As a result of the P-11 site cleanup, potential airborne contamination and subsequent migration of radioactive material in the event of a range fire or other natural phenomena will be eliminated. The removed radioactive materials will be stored and controlled in the same manner as other similar wastes in the Hanford 200 Areas. (TFD)

24798 (ARH-SA-192) CHEMICAL BEHAVIOR AND GROUND MOVEMENT. Smith, A. E.; Brown, D. J.; Isaacson, R. E. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 1974. 10p. (CONF-740434-6). Dep. NTIS $4.00.

From waste management symposium; Tucson, Arizona, USA (21 Apr 1974).

Waste management practices at Hanford are based on 30 y of experience and special studies. Aqueous high-level wastes are being converted to salt cakes in underground tanks. Wastes that leak into the ground due to corrosion of tank liners are absorbed in the Hanford sediments beneath the tanks and become fixed in place by natural processes. Water from the equivalent of a thousand years of rainfall in one deluge would not likely move the radioactive materials such as plutonium, strontium and cesium to the water table. (auth)

24799 (CONF-740315-2) HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT PROGRAM AT THE NATIONAL REACTOR TESTING STATION. Slansky, C. M. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs-Operations Office). 7 Mar 1974. Contract AT(10-1)-1375. 33p. Dep. NTIS $4.75.

From 3rd analytical calorimetry symposium; Los Angeles, California, USA (31 Mar 1974).

High-level radioactive waste is produced at the ICPP during the recovery of spent highly-enriched nuclear fuels. The management of the high-level waste is performed in accordance with the latest requirements and regulations for such waste. Liquid waste is stored safely in doubly-contained tanks made of stainless steel. The liquid waste is calcined to a solid and stored safely in a retrievable form in doubly-contained underground bins. The calcine can be treated further or left untreated in anticipation of ultimate storage. Fluidized-bed calcination has been applied to many kinds of high-level waste. The environmental impact of high-level waste management at the ICPP has been negligible and should continue to be negligible. (auth)

24800 (DP-1347) CHEMICAL COMPOSITIONS OF SUPERNATES STORED IN SRP HIGH LEVEL WASTE TANKS. Ondrejcin, R. S. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Aug 1974. Contract AT(07-2)-1. 24p. Dep. NTIS $4.00.

High-level radioactive wastes from the Savannah River Plant separations processes are stored in large, underground, carbon steel tanks. Wastes accumulate in three forms: supernate, sludge, and salt cake. As carbon steel is susceptible to stress-corrosion cracking (SCC) and cracks have been observed in several of the tanks, studies are in progress to determine the effects of supernate on SCC of tank materials. The results of chemical analyses of separations process waste supernates from sixteen waste storage tanks (seven in F-Area and nine in H-Area) are reported. Waste compositions must be known to evaluate corrosion phenomena that may limit the life of storage tanks. For example, the analyses provide a basis for preparing synthetic, nonradioactive wastes for corrosion studies simulating actual tank and cooling soil exposures. The average $[NO_3^-]/[NO_2^-]$ ratio of supernates from 16 tanks was 1 in F-Area and 3 in H-Area. The high ratio in H-Area could increase the tendency for these wastes to cause stress corrosion cracking. Other nonradioactive constituents analyzed in the supernates were Na, $Al(OH)_4^-$, OH^-, CO_3^{-2}, SO_4^{-2}, PO_4^{-3}, Cl^-, CrO_4^{-2}, F^-, Fe, Hg, NH_4^+, Ag, Pb, and U. Analyses were also performed for seventeen radioactive species: $^{134,137}Cs$, at about 10^{10} d/(min) (ml), contributed about 99% of the gamma activity; $^{103,106}Ru$ contributed about 10^7 d/(min) (ml). $^{89,90}Sr$, both biologically important beta emitters, were quite low, as expected, at about 10^5 d/(min) (ml). Plutonium alpha was practically absent at 10^3-10^4 d/(min) (ml). The reducing normality and density were also measured. The electrochemical behavior of the mild steel used to construct the waste tanks was similar in either actual waste supernates or synthetic solutions. This similarity indicates that the results of laboratory corrosion tests should be directly applicable to the actual waste tanks. (auth)

24801 (EUR-CEA-FC-723) STUDY OF THE NEUTRON TRANSMUTATION OF RADIOACTIVE RESIDUES FROM THE REPROCESSING OF IRRADIATED FUELS. Bretot, D. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Dec 1973. 38p. (In French). Dep. NTIS (US Sales Only) $5.00.

Studies effected in the USA on the possibility of destroying the most dangerous radioactive residues by neutron transmutations are analyzed. After a period of several years, the most dominant radioisotopes in such residues are ^{137}Cs (half-life = 30 y) and ^{90}Sr(half-life = 28 y). The transmutation of these two radioisotopes into stable elements halves the noxiousness of these residues during the intermediate term (several hundred years). In the long term (several thousand years), actinides present the greatest hazards. The recycling of actinides in reactors, as is the case for plutonium, can be envisaged. The work done in this field demonstrates the need for developing highly efficient methods (99%) for extracting the elements to be transmuted together with very high energy flux, high intensity (10^{15} n/cm^2 · s) sources. Water reactors such as those currently used for the production of electrical energy are of little interest for transforming residues, other than for the particular case of ^{85}Kr. Fast neutron reactors are far more interesting in this respect and in particular for actinides. Future thermonuclear reactors offer the greatest possibilities for the effective treatment of residues. (FR)

24802 (JAERI-M-5615) SOLIDIFIED PRODUCTS OF HIGH LEVEL RADIOACTIVE WASTES AND THE SAFETY EVALUATION. Tashiro, S. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 39p. (In Japanese). NTIS (US Sales Only).

It is recent world trend to solidify the high-level radioactive wastes generated by the fuel reprocessing and store them in solid forms. In Japan the concern with this subject has increased rapidly, and the full-scale development project will start in the near future. In order to establish some specific management system for the wastes which is suitable to the situation of the nuclear industry, it seems that the safety evaluation of the solidified product is important. The following issues that contribute the future development of the waste management in the country are described; background for high-level radioactive waste solidification, the types and properties of products, and safety evaluations. (auth)

24803 (LA-5666-PR) TRANSURANIC SOLID WASTE MANAGEMENT RESEARCH PROGRAMS. Quarterly Report, January-March 1974. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1974. Contract W-7405-eng-36. 25p. Dep. NTIS $4.00.

Research progress for three transuranic solid waste management research programs funded by the AEC Division of Waste Management and Transportation during the period of January-March 1974 is reported. The interim storage criteria have been redesignated as guidelines and will be issued as a Los Alamos Scientific Laboratory document after incorporation of final revisions. Studies of corrosion of mild steel in humid air have shown that Zinc Chromate Underseal, Chemical and Water-Resistant Rustoleum Industrial Coating, and Rust Gard do not prevent corrosion. Analyses of the gaseous products of radiolysis of cellulosics contaminated with 1.2 mg ^{238}Pu/g waste matrix have shown hydrogen and carbon dioxide to be the major products. Waste production is being evaluated on an individual process basis, and flowsheets are being prepared to show material input and waste output for each plutonium handling process. The Transuranic-Contaminated Solid Waste Treatment Development Facility has been redesigned to permit increased research ability and flexibility. The program to evaluate past burial practices has been redirected to emphasize local burial areas. Fluid dynamics computer codes are being evaluated for use in soil transport, atmospheric dispersion, and resuspension models. Agricultural and population data are being obtained for the areas surrounding Los Alamos. (auth)

24804 (MLM-2169(OP)) TRITIUM EFFLUENT CONTROL LABORATORY. Kershner, C. J.; Bixel, J. C. (Mound Lab.,

Miamisburg, Ohio (USA)). 1974. Contract AT-33-1-GEN-53. 23p. (CONF-740807-8). Dep. NTIS $4.25.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

A new "Tritium Effluent Control Laboratory" is described. The function of the laboratory is to provide experimental and pilot type facilities for research and development of tritium effluent control systems for recovering tritium from waste gas streams. The goal of the facility is to develop and demonstrate technology and equipment to maintain emissions to the atmosphere below 10% of Radioactivity Concentration Guide levels. Two helium atmosphere glovebox lines are provided. An air box which interconnects the two helium box lines is used for equipment transfers and decontamination. In addition, a cryogenic helium purification system services both helium gloveboxes to maintain tritium levels at less than 1 ppM. A catalytic oxidation and oxide adsorption air detritiation system traps tritium released to the air box during equipment transfer operations. The air is recirculated for tritium removal before the air box is opened for equipment removal. This system is also used as an effluent treatment system to remove and contain tritium from other miscellaneous laboratory gas streams. The laboratory support systems include an "Emergency Containment System" (ECS) which is actuated automatically upon accidental release of tritium to the laboratory or equipment room areas, preventing release of tritium from the laboratory air to the exhaust stack and outside environment. Upon actuation, personnel will be evacuated and the area will be sealed. The contaminated room air will then be recirculated through the ECS which consists of a catalytic oxidation reactor and an oxide adsorption column. The released tritium will be contained on the adsorption column in the oxide form. During this emergency condition, laboratory systems may be controlled from a location outside the contaminated area. Glovebox experiments directed toward the development goal of a closed tritium cycle are described. (auth)

24805 (NP-20127) RADIOACTIVE RESIDUES, THEIR ORIGIN AND ELIMINATION. KS-Information Brief Report No. 20. (Werner und Pfleiderer Maschinenfabrik, Stuttgart (F. R. Germany)). [nd]. 26p.

The report is primarily a description of a continuous, fully automatic process for the solidification of high-level liquid wastes in a bituminous material. Methods for the disposal of radioactive wastes are also reviewed. (TFD)

24806 (WASH-1530(Final)) ADDITIONAL HIGH LEVEL WASTE FACILITIES, SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA. Final Environmental Statement. (USAEC, Washington, D. C.). Aug 1974. 120p. Dep. NTIS $9.00.

The proposed addition to present radioactive waste management facilities consists of six 1.3 million gallon tanks, a waste evaporator and associated auxiliaries at an estimated cost of $30 million. The tanks will be constructed of mild steel and each enclosed in a steel-lined underground concrete containment vessel. They will be used for interim storage of radioactive waste generated by the production of nuclear materials. The stainless steel evaporator will be used to dewater the wastes by a factor of approximately one third. The facilities will be constructed at the Savannah River Plant of the AEC located in Aiken and Barnwell Counties in South Carolina. The environmental impacts from this project will result from the temporary construction disruptions and the releases of small amounts of radioactivity during operation of the evaporator. The radioactivity released will produce an offsite population exposure of less than one tenth of a percent of the dose received from natural sources. (TFD)

24807 (WASH-1532) RADIOACTIVE WASTE FACILITIES. Final Environmental Statement. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. 112p. Dep. NTIS $8.75.

The proposed action consists of the design, construction and operation of two additional radioactive waste storage tanks, an evaporator and associated equipment at the Oak Ridge National Laboratory in Roane County, Tenn. The project is estimated to cost $9.5 million and the facilities placed into operation about 1977. The environmental impact of the construction and normal operation of the facilities is expected to be temporary in the case of the construction and minimal in the case of normal operations. Accidental spills of radioactive waste are not expected to result in radiation exposures exceeding prescribed standards. (TFD)

24808 (WASH-1532(Final)) RADIOACTIVE WASTE FACILITIES, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TENNESSEE. Final Environmental Statement. (USAEC, Washington, D. C.). Aug 1974. 111p. Dep. NTIS $8.75.

The proposed action consists of the design, construction, and operation of two additional radioactive waste storage tanks, an evaporator and associated equipment at the Oak Ridge National Laboratory in Roane County, Tennessee. The project is estimated to cost $9.5 million and the facilities placed into operation about 1977. The environmental impact of the construction and normal operation of the facilities is expected to be temporary in the case of the construction and minimal in the case of normal operations. Accidental spills of radioactive waste are not expected to result in radiation exposures exceeding prescribed standards. (TFD)

24809 (Y-DD-142) PROGRAMMATIC DESCRIPTION FOR ENVIRONMENTAL MONITORING AND POLLUTION ABATEMENT AT THE Y-12 PLANT. Sanders, M. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1974. Contract W-7405-eng-26. 27p. (CONF-740406-22). Dep. NTIS $4.50.

From second AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

The Oak Ridge Y-12 Plant is operated by Union Carbide Corporation for the United States Atomic Energy Commission and processes, on an industrial scale, material involving potential environmental hazards. To ensure safe operating conditions, extensive environmental sampling programs are maintained. A variety of unique techniques for pollution abatement are discussed with emphasis on an effective waste management program for a large industrial complex. (auth)

24810 DISPOSAL OF RADIOACTIVE WASTES. Ishihara, T. (Japan Atomic Energy Research Inst., Tokai). Karyoku Genshiryoku Hatsuden; 24: No. 5, 559-566(May 1973). (In Japanese).

Nuclear power generation differs from thermal power generation mainly in the generation of radioactive wastes and the necessity for their disposal. However, this aspect in nuclear power stations is not so grave as in case of fuel reprocessing facilities; these two aspects must be studied separately. In Japan, nuclear power generation is proceeding with strict control of the radioactive wastes produced. The disposal of the radioactive wastes from nuclear power plants, centered in Japanese practices is described as follows: the measures taken so far in Japan; ocean disposal, including release in coastal water and deep-sea disposal; land disposal, including on-land storage and underground disposal; the disposal of gaseous wastes; and problems for the future. (JA)

24811 PRESENT STATUS OF RADIOACTIVE WASTE MANAGEMENT. I. Nakajima, T. (Japan Atomic Energy Research Inst., Tokai). Kagaku (Kyoto); 43: No. 8, 501-507(Aug 1973). (In Japanese).

The fundamental concept and historical background of radioactive waste management are reviewed. The fundamental features of radioactive wastes are discussed together with some definition of the technical terms for waste storage accepted at the international panel held at Vienna, in Nov. 1972. As to the historical background, the systematic waste gathering and storing system being practiced in Japan since 1959 is described. The basic principles for radioactive waste management adopted by the Japanese AFC after deliberation from 1961 to 1964 are also reviewed with the comment that some of those principles are no longer acceptable. The estimated volume and activity of radioactive wastes that have been and will be released annually from various sources in Japan are shown. It is evident that most of the total volume is due to power plants and total activity to reprocessing plants. Although high level liquid wastes are stored in many tanks at present, the solidification of these wastes may become indispensable in the near future. The methods of pretreating liquid wastes, e.g., evaporation, ion-exchange, and precipitation processes are briefly reviewed. An outline for the solidification of these concentrated liquids is also presented. (JA)

24812 PRESENT STATUS OF RADIOACTIVE WASTE MANAGEMENT. II. Nakajima, T. (Japan Atomic Energy Research Inst., Tokai). Kagaku (Kyoto); 43: No. 11, 703-712(Oct 1973). (In Japanese).

In the first part, the sources and mechanism for the production of radioisotopes in reactors are discussed. The calculated release rate of each radionuclide from 1000 MW(e) PWR and BWR plants (assumed to have been operated for 10 y) is tabulated. The flow from generation to the final release to environment of radioactive wastes in each type of plant is also shown. The actual records on the total release of radioactive wastes in 1971 from typical American BWR and PWR plants are presented. In the second part, the management of radioactive wastes in reprocessing plants is discussed with emphasis on the reprocessing of LWR fuel by Purex method. The present status and future trend of waste management are discussed regarding gas, solid and liquid wastes. In the third part, the problems associated with the evaluation of the effect of

radioactivity to environment are widely discussed referring to many recent reports. It is emphasized that the establishment of calculation models and the monitoring system suitable for highly populated Japan to check the effect of radioactive wastes are necessary. In the fourth part, the method of final disposal of radioactive wastes is discussed centering on disposal at sea. Finally, the study emphasizes that safe methods for radioactive waste management are more important than the hasty construction of nuclear power plants. (JA)

24813 NUCLEAR FISSION FALLOUT OF FAST REACTORS. A Comparison With Nuclear Fission Fallout from Light Water Reactors. Hamstra, J.; Verkerk, B. Atoomenergie Haar Toepass.; 16: No. 5, 103-108(May 1974). (In Dutch).

A review is given of the radiotoxic hazards as a result of the disposal into a deep geological formation of high-level reprocessing wastes of fast breeder reactor fuels, mainly by making a comparison with earlier published data on the disposal of the high-level reprocessing wastes of light water reactor fuels. In comparing the radiotoxic hazards of buried reprocessing wastes for both types of reactor fuels with that of an equivalent amount of uranium ore, its mill tailings and the enrichment tailings, the conclusions are drawn that the overall radiotoxic hazard of the wastes from a fast reactor fuel cycle will be less than that of a light water reactor fuel cycle; a real radiotoxic hazard for buried high-level reprocessing wastes of both reactor types only exists for the first 300 to 500 years of its burial. (auth)

24814 RADIOACTIVE WASTE: PRESENT PROBLEMS. Girardi, F.; Bertozzi, G. (Commisson of the European Communities, Ispra, Italy). Euro-Spectra; 13: No. 1, 23-29(Mar 1974).

After discussing natural radioactivity and the environmental effects of all current energy-producing methods, the contribution of the nuclear industry to increased environmental radioactivity is evaluated. It is concluded that the radioactive waste problems posed by the greater use of nuclear energy can be solved. (LCL)

Handling Equipment and Procedures

Refer also to abstract 25889.

24815 (ORNL-tr-2825) RAPID METHOD OF CALCULATING THE FLUX AND NEUTRON SPECTRA IN THE CASE OF A CRITICALITY ACCIDENT (CARNAC PROGRAM). Bessis, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). 1973. Translated by Martha Gerrard from CEA-N-1612. 45p. Dep. NTIS $5.25.

The proposed calculation method is unsophisticated but rapid. The first part (computer code CRITIC), which is based on the Fermi age equation, evaluates the number of neutrons per fission emitted from a moderated critical assembly and its energy spectrum. The second part (computer code NARCISSE), which uses concrete current albedo, evaluates the product of neutron reflection on the walls and calculates the flux resulting at any point and its energy distribution by 21 groups. The results obtained seem satisfactory when compared to a Monte Carlo program. (auth)

24816 (RFP-2209) INERT ATMOSPHERE SYSTEM FOR PLUTONIUM PROCESSING GLOVEBOXES. Bogard, C. F.; Calkins, K. W.; Rogers, R. F. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 1974. 13p. (CONF-740807-1). Dep. NTIS $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

Recent efforts to reduce fire hazards in plutonium processing operations are described. In such operations, the major environmental controls are developed through various kinds of glovebox systems. In evaluating the air-atmosphere glovebox systems, formerly in use at Rocky Flats and many other plants, a decision was made to convert to a recirculating "inert" atmosphere. The inert atmosphere consists of nitrogen, supplied from an on-site generating plant, diluting oxygen content to between one and five percent by volume. Problems encountered during the change-over included: determination of all factors influencing air leakage into the system, and reducing leakage to the practical minimum; meeting all fire and safety standards on the filter plenum and exhaust systems; provision for converting portions of the system to an air atmosphere to conduct maintenance work; inclusion of oxygen analyzers throughout the system to check gas quality and monitor for leaks; and the use of automatic controls to protect against a variety of potential malfunctions. The current objectives to reduce fire hazards have been met and additional safeguards were added. The systems are operating satisfactorily. (auth)

24817 CRITICAL EXPERIMENTS TO MEASURE THE NEUTRON POISONING EFFECTS OF COPPER AND COPPER–CADMIUM PLATES. Bierman, S. R.; Clayton, E. D. (Battelle Memorial Inst., Richland, WA). Nucl. Sci. Eng.; 55: No. 1, 58-66 (Sep 1974).

There has been considerable interest in the use of fixed neutron absorbers (poisons) for criticality control since their use would permit safely handling larger quantities of nuclear materials with reduced probability of criticality. The effectiveness of such absorbers as neutron poisons depends on self-shielding effects which in turn are determined by the magnitude of the absorption cross sections and their variation with energy, the thickness of material, and the neutron-energy spectrum. For the fixed poisons to be considered as either a primary or secondary means of criticality control, their use must be based on a firm knowledge of these effects. To obtain experimental data in this area, the reactivity worth of two such materials, copper and copper containing 1 wt % cadmium, was recently measured in two different energy spectrums and at different thicknesses up to ~2½ cm. The results of these measurements are presented and provide a set of clean, well-defined, poisoned critical assemblies that can be used to check calculational techniques and cross-section data. In the relatively thermalized neutron-energy spectrum, very little additional absorption was observed in the copper plate at thicknesses greater than ~2½ cm or in the copper–cadmium plate at thicknesses greater than 1 cm. At thicknesses greater than these, self-shielding precluded any additional absorption, and the change in reactivity was due almost entirely to the additional void being introduced into the system by the poison plates. In the relatively fast neutron energy spectrum, neutron absorption was observed to continually increase with plate thickness for both sets of plates. However, in this spectrum the void effects, caused by the presence of the poison plates, had a greater reactivity worth, over the thickness range covered, than the neutron absorption. In either spectrum, the 1 wt % cadmium in the copper contributed significantly to the neutron absorption. Of course, the cadmium was found to be worth much more in the thermalized spectrum. (auth)

24818 CRITICALITY OF PLUTONIUM–URANIUM MIXTURES CONTAINING 5 to 8 wt % PLUTONIUM. Lloyd, R. C.; Bierman, S. R.; Clayton, E. D. (Battelle Memorial Inst., Richland, WA). Nucl. Sci. Eng.; 55: No. 1, 51-57(Sep 1974).

Results are presented from a series of criticality experiments with homogeneous plutonium–uranium fuel mixtures with plutonium content in the range of 5 to 8 wt %. The H: (Pu + U) atomic ratios covered a range from 19.5 to a high of 80.7: the experiments provide data in the region of moderation where the minimum critical volume occurs for homogeneous plutonium–uranium systems with a plutonium content of 8 wt %. The minimum critical spherical radius for material containing 8 wt % Pu in $PuO_2 - UO_2$ – water mixtures was determined to be 14.98 cm. The criticality factors were computed with neutron transport theory and Monte Carlo calculations, using the DTF-IV and the KENO-II codes with both ENDF/B-II and ENDF/B-III version cross sections. The calculated values were found to be within ±2% of unity. (auth)

Transportation

Refer also to abstract 23748.

24819 (ORNL-TM-4631) PROJECTED SHIPMENTS OF SPECIAL NUCLEAR MATERIAL AND WASTES BY THE NUCLEAR POWER INDUSTRY. Blomeke, J. O.; Kee, C. W.; Salmon, R. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 67p. Dep. NTIS $6.50.

Based on a current forecast of nuclear power growth in the U. S. and on conceptually designed shipment systems, the logistics are examined for a fuel cycle industry (excluding power generation, mining, milling, and enrichment) that develops along either of two paths: (1) an extension of current industrial patterns consisting of independently-sited, dispersed facilities; and (2) a single, integrated fuel cycle facility with capabilities for fuel fabrication, reprocessing, and retrievable surface-storage of wastes. This study shows that about 112,000 individual shipments of strategic nuclear material, spent fuel, and wastes will be required for dispersed facilities in the year 2000, with an average of 514 loaded vehicles being in transit at any time. By comparison, a single, integrated nuclear cycle facility would require only about 25,600 shipments with 450 loaded vehicles in transit. (auth)

24820 (RMI-L-67) SAFETY ANALYSIS REPORT FOR PACKAGING. Steel Banded Rectangular Steel Skids and Steel Banded Wooden Shipping Containers for Slightly Enriched Uranium Metal. Schaeffer, M. R. (Reactive Metals, Inc., Ashtabula, Ohio (USA)). Aug 1974. Contract AT(30-1)-1405. 29p. Dep. NTIS $4.00.

This document contains individual safety analysis reports for two containers routinely utilized by RMI Company in the offsite shipment of slightly enriched uranium metal. They have been combined into one document since they are both used for the Fissile Class III shipment of slightly enriched uranium, 1.25% ^{235}U maximum, in solid metal form. (auth)

24821 (WASH-1264(Rev.)) EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT SHIPPING HIGH-LEVEL NUCLEAR WASTES. (USAEC Division of Waste Management and Transportation, Washington, D. C.). Aug 1974. 49p. Dep. NTIS $4.00.

Sixty-eight "most often asked" questions concerning the safety of high-level waste shipping with detailed answers are presented. Although the questions and answers are aimed specifically at transportation of nuclear wastes, many of them are equally applicable to shipments of other nuclear materials, such as spent fuel elements and large amounts of radioisotopes. (TFD)

24822 SHIPMENT OF RADIOACTIVE MATERIALS. Shappert, L. B. (Oak Ridge National Lab., TN). pp 151-176 of Human and Ecological Effects of Nuclear Power Plants. Sagan, L. A. (ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

Regulations and methods for shipping radioactive materials resulting from the fuel cycle of nuclear power plants are reviewed. (TFD)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 25253 and 25506.

24823 (BNL–19076) SOME COMMENTS ON AGS BUNCH AREAS. Barton, M. Q. (Brookhaven National Lab., Upton, N.Y. (USA)). 17 Jul 1974. 4p. Dep. NTIS $4.00.

Recently, Fainberg and Kalogeropoulos measured the bunch width in a bunched extracted beam at the AGS. This width is probably less than that of the internal beam. Application of their method to the internal beam is possible. (auth)

24824 (FRNC-TH-482) STUDY AND DEVELOPMENT OF AN INTENSE RELATIVISTIC ELECTRON BEAM. Application to the Construction of a Transport Line for a Collective Accelerator for Ions. Dupuy, J. P. (Paris-11 Univ., 91 – Orsay (France)). 1973. 112p. (In French). Dep. NTIS (U. S. Sales Only) $8.75.

Thesis.

The development of a collective accelerator of ions (smokatron) is discussed. The principles and operation of this type of accelerator are reviewed. The Saclay project is described together with the decisions made. The purpose of the work undertaken was the study and development of equipment capable of producing a 2.5 MeV electron beam having an intensity of a few hundred amperes together with its transport up to the compressor. The work was dominated by the requirements of the ring, i.e., small radial size and the highest possible intensity. It was also necessary to take into consideration the intense space charge and the large energy dispersion taking place. (FR)

24825 (IPNO-73-01) PROCEEDINGS OF THE 10th EUROPEAN CYCLOTRON PROGRESS MEETING, GRONINGEN, 4–7 SEPTEMBER 1973. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). 1973. 17p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

A brief review is given of the status reports and papers presented at the 10th European cyclotron progress meeting (Groningen) concerning the characteristics of operational cyclotrons, the state of progress achieved in the development of new cyclotrons and the transformations undertaken on existing machines. The following current projects are considered: TRIUMF (Vancouver), Vicksi (Berlin), SIN (Villegen), and transformations of operational synchrocyclotrons and cyclotrons of Chiba, Grenoble, Groningen, Harwell, Karlsruhe and Milan. (FR)

24826 (LBL-2489) COMPRESSOR DESIGN FOR INTENSE ELECTRON RINGS. Hauptman, J.; Laslett, L. J.; Chupp, W. W.; Keefe, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 7p. (CONF-740522-36). Dep. NTIS $4.00.

From ninth international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

An electron ring compressor is being designed for the purpose of obtaining very highly-stripped, high-Z ions. This effort may constitute a necessary step for development of a possible heavy ion accelerator, is expected to lead to useful basic ion-source information, and independently will permit obtaining interesting spectroscopic information concerning such ions. The primary design objective is the achievement of a ring of high electron density that must retain this density and remain stable for a sufficient time to develop the desired highly-stripped ions. A density-time product in the vicinity of 10^{13} electron-sec/cm^3 may be required. Vacuum requirements become undesirably stringent if the time interval exceeds 1 sec. Synchrotron radiation over such time periods play a dominant role in the design, and a proper shaping of the magnetic field is presented which employs synchrotron radiation to enhance ring quality while avoiding both single particle resonances and the onset of negative-mass instability. (WHK)

24827 METHOD FOR ACCELERATING NUCLEI IN THE SYNCHROPHASOTRON AT THE JOINT INSTITUTE FOR NUCLEAR RESEARCH. Donets, E.D.; Kazanskii, G.S.; Mikhailov, A.I.; Smirnov, A.A. (Joint Institute for Nuclear Research, Dubna). Sov. Phys.–Tech. Phys. 18: No. 10, 1333-1335 (Apr 1974).

The acceleration of heavy nuclei in the synchrotron mode is discussed. We consider methods to minimize the loss of the accelerated nuclei and calculate cross sections for capture of electrons and the resulting loss. (AIP)

24828 ELECTRONIC LOAD IN THE ACCELERATING TUBES OF AN ELECTROSTATIC ACCELERATOR. Zheleznikov, F.G.; Yakovlev, N.M.; Bersenev, Y.T. (D. V. Efremov Scientific-Research Institute of Electrophysical Apparatus, Leningrad). Sov. Phys.–Tech. Phys. 18: No. 10, 1388-1389 (Apr 1974).

Experiments have been carried out to determine the nature of the electronic load which arises in accelerating tubes. A study has been made of the emission properties of dielectric formations which form on the cathode during discharges between electrodes contaminated by organic impurities. The emission properties of the dielectric formations are found to be like those of Malter emitters. (auth)

24829 DOWNTIME EXPERIENCE FOR CLINICAL LINEAR ACCELERATORS. Bjärngard, B.E.; McEwen, D.A. (Joint Center for Radiation Therapy, Harvard Medical School, 50 Binney Street, Boston, Massachusetts 02115). Med. Phys. 1: No. 2, 77-78 (Mar 1974).

The downtime for four linear accelerators in clinical radiation therapy has been studied for about four years. The time lost during patient treatment hours is on the average 3% with an in-house technical service group, which invests approximately 1000 man-hours per machine and year in preventive maintenance and repair. The time lost decreases significantly with time after installation. (auth)

24830 PROTON EMISSION FROM MICROINSTABILITIES IN AN ELECTRON-BEAM DIODE. Johnson, D.J.; Kerns, J.R. (Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico 87117). Appl. Phys. Lett. 25: No. 4, 191-192 (15 Aug 1974).

The radial proton emission from a 5-MV 50-kA electron-beam diode with polyethylene anode has been spatially and spectrally measured with pinhole cameras and ion-sensitive vacuum diode detectors. The spatial measurements indicate that the protons originate from electron-beam pinches less than 200 μm in diameter. The proton spectrum measured between 80 keV and 3 MeV is in qualitative agreement with published data for a computer simulation of proton acceleration via the relativistic electron-ion two-stream instability in a tightly pinched electron beam. (auth)

24831 PERFORMANCE OF 6-m 1300-MHz SUPERCONDUCTING NIOBIUM ACCELERATOR STRUCTURES. Turneaure, J.P.; Schwettman, H.A.; Schwarz, H.D.; McAshan, M.S. (Department of Physics and High Energy Physics Laboratory, Stanford University, Stanford, California 94305). Appl. Phys. Lett. 25: No. 4, 247-249 (15 Aug 1974).

The design, manufacture, and performance of several 6-m-long 1300-MHz superconducting niobium accelerator structures, which are part of the Stanford superconducting accelerator, are briefly described. In these standing-wave accelerator structures, we have achieved cw energy gradients as high as 3.8 MeV/m and unloaded Q's as high as 6.9×10^9 measured at 3.0 MeV/m and 1.9 K. In addition, electron-beam currents up to 5000 μA have been accelerated through the structure without exciting beam-breakup modes. (auth)

Auxiliaries and Components

Refer also to abstract 24040.

24832 (AED-CONF-74-044-007) AN INDUCTION MONITOR AND A MEASURING DEVICE FOR DETERMINING THE CHARGE OF SINGLE BEAM PULSES FOR AN ELECTRON LINAC. Stephan, G. (Mainz Univ. (F. R. Germany). Inst. fuer Kernphysik). 1974. 8p. (In German). INIS.

From exhibition and experts' meeting "Nuclear Technology"; Frankfurt am Main, F. R. Germany (18 Mar 1974).

8 figs.; 6 refs.

The monitor described can be used for pulse currents of 5 μA up to 80 mA. It is independent of pulse time and pulse shape over a wide range (20 nsec up to 20 μsec). Its accuracy over the entire measuring range is 5 parts per thousand. As the charge information of each linac pulse is processed separately by the electronic equipment, this facility is particularly well-suited to relative measurements of cross sections with rapidly changing targets. (auth)

24833 (AERE-PR/NP-20, pp 52-53) BEHAVIOUR OF CARBON STRIPPER FOILS UNDER HEAVY ION BOMBARDMENT. Armitage, B. H.; Porter, D. R.; Whitmell, D. S. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1974.

24834 (ITEF-78) CALCULATION OF RADIATION PROTECTION OF THE PREMISES OF THE MEDICAL-BIOLOGICAL PROTON BEAM OF THE ITEP. Reznik, B. I.; Lomanov, M. F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 27p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

Some methods for the calculation of the radiation protection for the 200-MeV proton beam at the ITEP synchrotron were examined. Typical operating graphs and characteristics of different forms of irradiation with the large beam for medical purposes are reported. On the basis of these graphs, conclusions are drawn on the radiation environment in the vicinity of the medical beam after reconstruction of the accelerator. Calculations were made on the radiation protection in specific conditions of the medical beam of the ITEP for different energies and intensities of the extracted beam. Some results of the calculations are compared with experimental data. (tr-auth)

24835 (JAERI-M-5454) AUTOMATIC VOLTAGE CONDITIONER FOR THE JAERI 5.5 MV VAN DE GRAAFF ACCELERATOR. Sato, Y.; Yoshida, T. (Japan Atomic Energy Research Inst., Tokyo). Nov 1973. 17p. (In Japanese). NTIS (US Sales Only).

An automatic voltage conditioning device, built for the JAERI 5.5 MV Van de Graaff accelerator, is described and its operational performance discussed. It can condition the accelerator to a required energy without surveillance. It has built-in features to safeguard against seven abnormal situations in the operation of the accelerator. (auth)

24836 (JINR-1-7451) SIX-CHANNEL ANALOG-TO-DIGITAL CONVERTER. Zanevskii, Yu. V.; Ivanov, A. B.; Filatova, N. I.; Chernenko, S. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 8p. (In Russian). INIS.

A unit containing six 12-bit analog-digital converters with 10-MHz frequency is described. The unit, located in the CAMAC assembly, was developed for a beam diagnosis system used on the IFVE accelerator. The conversion time is 25.5 μsec and the measurement precision in a region from 20 mV to 2 V is ~ 1%. (tr-auth)

24837 (JINR-9-6793) ACCELERATING VOLTAGE PHASE AND AMPLITUDE CONTROL WHILE ACCELERATING HEAVY PARTICLES ON THE JINR SYNCHROPHASOTRON. Mikhailov, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 15p. (In Russian). INIS.

The possibility of eliminating the loss of beam intensity during operation of the JINR synchrophasotron in the regime of transition from the first stage of acceleration to the second by modulation of the phase and amplitude of the accelerating voltage from data on the rate of change of the magnetic field was examined. The control circuit of the phase of the accelerating voltage is described. The results of the operation of the phase modulator with this circuit are reported. (tr-auth)

24838 (LBL-1294) WIDE-BAND DRIVEN RF SYSTEM FOR THE BERKELEY 88-INCH CYCLOTRON. Flood, W. S.; Frazier, P. E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1972. Contract W-7405-eng-48. 8p. (CONF-720717-10). Dep. NTIS $4.00.

From 6th international cyclotron conference; Vancouver, B. C., Canada (18 Jul 1972).

The wide-band driven rf system, recently commissioned at the Berkeley 88-Inch Cyclotron, offers a much needed lever on dee voltage stability at no sacrifice in rapid tuning flexibility, hopefully at a substantial reduction in tube replacement costs comparative to the original oscillator rf power source. (auth)

24839 (RL-74-081) NEW INJECTOR FOR NIMROD: BEAM DIAGNOSITCS PRE-INJECTOR EMITTANCE MEASURING EQUIPMENT. Swales, F. (Science Research Council, Chilton (UK). Rutherford Lab.). 5 Mar 1974. 6p. Dep NTIS (US Sales Only) $4.00.

The emittance is measured using a two slit method, where a Faraday cup behind a slit measures the beam density in the angular dispersion from an upstream slit. A general description of the equipment is given. The use of the emittance equipment allows the evaluation of beam profiles and transverse emittance. Sections of the report deal with: geometrical data, measuring range, errors, quadrupole triplet settings, and electronics. (UK)

24840 EXPERIMENTAL AND CALCULATED BREMSSTRAHLUNG SPECTRA FROM A 25-MeV LINEAR ACCELERATOR AND A 19-MeV BETATRON. Levy, L.B.; Waggener, R.G.; McDavid, W.D.; Payne, W.H. (Department of Radiology, The University of Texas Health Science Center at San Antonio, San Antonio, Texas 78284). Med. Phys. 1: No. 2, 62-67 (Mar 1974).

The bremsstrahlung spectra from a 25-MeV linear accelerator and a 19-MeV betatron have been measured using a NaI(Tl) spectrometer system. The spectra show a low energy cut-off at 0.6 and 0.4 MeV, respectively, and the maximum photon energies were 26.8 and 19 MeV, respectively. Cross sections, thin- and thick-target photon spectra and total electron energy losses (collision and radiative) were computed using a digital computer for tungsten (Z=74) and platinum (Z=78) targets. The measured spectra were compared to the calculated spectra for thin and thick targets using electron kinetic energies of 26.75 and 19 MeV. The photon spectra from the two therapy units are different; however, depth dose data (10×10 cm, 100 cm TSD) are approximately the same. In addition, narrow-beam attenuation coefficients in lead for the two machines were measured. The effective energy derived from the first HVL was 8.1 MeV for the linear accelerator and 7.8 MeV for the betatron. (auth)

Ion Sources and Injection and Extraction Systems

24841 (IPNO-73-04) PROGRESS REPORT (1973) ON THE CONFINED HEAVY ION SOURCE. Arianer, J.; Baron, E.; Ton-That, T. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1973. 17p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

A report is given on studies carried out over the past 2 years by the Heavy Ion Source group of the Institute of Nuclear Physics to develop a Donetz scheme based multicharged heavy ion source. The confinement principle is recalled together with the operation of this type of source. The characteristics of the Orsay model are described, i.e., directly heated electron gun; pressure of between 2 to 4×10^{-8} torr, Debye length; slowing down and stability of the beam; confinement time. The tube desorption products are currently limited to H_2, C, O, and to a lesser extent N. Methods are currently being studied for reducing the desorption by the walls. The current gun can reach current-densities of between 10^4 and $10^5 A/cm^2$. (FR)

24842 OPTIMIZING CONDITIONS FOR ACCELERATION AND BEAM EXTRACTION IN A CYCLOTRON WITH EXTERNAL "ACTIVE" MONOCHROMATIZATION. Basargin, Y.G.; Venikov, N.I.; Litunovskii, R.N.; Severgin, Y.P. (D. V. Efremov Scientific-Research Institute of Electrophysical Apparatus, Leningrad). Sov. Phys.-Tech. Phys. 18: No. 10, 1340-1342 (Apr 1974).

The optimization of acceleration and extraction in a cyclotron which monochromatizes the beam by means of the rf field of an external resonator is discussed. The particular case of a proton ring cyclotron operating at energies up to 200-300 MeV is described. The duty cycle can be improved insignificantly and the tolerances can be significantly relaxed in multiturn extraction. The required dimensions of the monochromatization system decrease with increasing order of the acceleration harmonic. It appears to be possible to produce a beam of several dozen microamperes and a transverse emittance of 3π mm·mrad with an energy spread of $2 \cdot 10^{-4}$ and a duty cycle of 0.2. (auth)

24843 POLARIZED ION SOURCES. Salzborn, E. (Giessen Univ. (F. R. Germany). Inst. fuer Kernphysik). Kerntechnik; 16: No. 6, 260-265(Jun 1974). (In German, English).

7 figs.; 17 refs.

Polarized ion sources are at present installed at almost all particle accelerators. Two ion source types are used for the generation of polarized proton and deuteron beams, namely, the atomic beam source and the Lamb shift source. Both types provide currents of about 1 μA with a polarization of 70 to 90%. The operating principles of these two source types are described in detail. Some other methods for the generation of polarized ions are also mentioned. (auth)

Ion Optics and Field Calculations

24844 (ITEF-79) CONCERNING TRI-COMPONENT ELECTRON-ION RINGS. Nikolaeva, L. P.; Koshkarev, D. G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The stability of electron-ion rings as compared to the resonance bonds of the transverse oscillation of the ions and electrons in the presence of heavy ion impurities was investigated. (tr-auth)

24845 (JINR-P-5-7394) CALCULATION OF PARAMETERS OF THE STATIONARY SELF-CONSISTENT RELATIVISTIC ELECTRON BEAM. Zhidkov, E. P.; Iliev, I. P.; Semerdzhiev, Kh. I.; Rubin, S. B. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 24p. (In Russian). INIS.

The model problem on the determination of the boundary of a circular electron beam existing within a cylindrical chamber and confined by an external magnetic field was examined by the variant method. The development of the method assumed the calculations would be made by computer. For completion of the

method, calculations were made for cases when the presence of a sufficiently large original dispersal of the transverse impulse of the particle at particle numbers $N > 10^{13}$ led to beams with relatively large transverse cross sections. (tr-auth)

24846 (LBL-3054) RAPPORTEUR TALK ON ELECTRON RING ACCELERATOR. Lambertson, G. R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 5p. (CONF-740522-37). Dep. NTIS $4.00.

From ninth international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The work on electron rings is characterized by the conflict between (1) the desire to maximize and utilize the collective fields of the ring and (2) the necessity of suppressing instabilities propagated through those same collective fields. The search for this balance has resulted in some analyses of the limitations one may expect on ring parameters. As an example, a particularly simple illustration of this that was presented by Jackson Laslett, which concerns the maximum rate of acceleration for ions in an electron ring, is given. (WHK)

24847 NONSTATIONARY CURRENT LOADING OF A LINEAR ELECTRON ACCELERATOR. Volodin, V.A. (Moscow Engineering Physics Institute). Sov. Phys.–Tech. Phys. 18: No. 10, 1380-1381 (Apr 1974).

A study is made of the loading of a uniform accelerating linac section by a biperiodic sequence of charged-particle bunches. The field excited by the beam is calculated. In the general case up to six current-loading modes, most of which are nonstationary, can occur over the length of the section. The results can be used to study the use of a linac as an electron injector for a coherent ion accelerator and to analyze the operation of the accelerating waveguide of cyclical accelerators with the ring partially filled with charged particles. (auth)

24848 UNDULATOR RADIATION. Alferov, D.F.; Bashmakov, Y.A.; Bessonov, E.G. (P. N. Lebedev Physics Institute, Moscow). Sov. Phys.–Tech. Phys. 18: No. 10, 1336-1339 (Apr 1974).

The radiation of charged particles in an undulator is analyzed in the general case. Equations are derived for the spectrum and polarization in an undulator with arbitrary field, in terms of an integral over the number of periodic elements and over the length of one such element. The optimum undulator field corresponding to maximum intensity per unit solid angle of the first-harmonic radiation is found. At this optimum field the radiation spectrum is highly monochromatic. (auth)

24849 ELECTRON BEAMS, LENSES, AND OPTICS. Volume II. El-Kareh, A. B.; El-Kareh, J. C. J. New York; Academic Press, Inc. (1970). 328p. $23.00.

Topics include geometrical aberrations of lenses, the spherical aberration of electric and magnetic lenses, measurement of the spherical aberration of various electric and magnetic lenses, theory of diffraction, the influence of space charge in high density electron beams, and chromatic aberration. (WHK)

24850 ELECTRON BEAMS, LENSES, AND OPTICS. Volume I. El-Kareh, A. B.; El-Kareh, J. C. J. New York; Academic Press, Inc. (1970). 423p. $25.00.

Topics by chapter title include electron beams and light rays, the paraxial ray in symmetrical electric fields, analytical determination of electrostatic fields, general properties of electrostatic lenses, the electrostatic immersion lens, the electrostatic unipotential lens, optical image formation by rotationally symmetrical magnetic fields, and the symmetrical magnetic lens. (WHK)

24851 ENERGY DISPERSION OF A QUADRUPOLE LENS. Siksin, V.S. (Institute of Nuclear Physics, Academy of Sciences of the Kazakh SSR, Alma-Ata). Sov. Phys.–Tech. Phys. 18: No. 9, 1153-1160 (Mar 1974).

General expressions are obtained for the energy dispersion of a beam in a system consisting of a 90-degree deflecting magnet and a doublet quadrupole lens. A characteristic dependence of the energy dispersion (in the form of curves with maxima) on the field parameters k_1 and k_2 of the individual doublet lens is observed for $k_1 \simeq k_2$. The energy dispersion is determined as a function of the position of the individual doublet lens and the distance (100-800 cm) from the last lens in the doublet to the crossover plane of the beam. Computer calculations show that for distances of 300-800 cm and various lens positions, the energy dispersion 1.5×10^{-4}–10^{-5}. It is shown that there are only two possibilities for obtaining small energy dispersion of a proton beam: operation of the doublet in the region $k_1 \simeq k_2 = (2-4) \times 10^{-4}$ cm^{-2} and $(22-24) \times 10^{-4}$, i.e., on the falling portions of the right and left sides of the energy-dispersion curves. The variation in the energy dispersion of a proton beam associated with changes in proton energy and the distance from the object (beam crossover) to the input lens of the doublet is determined. The distance from the output lens to the image, the magnification factor of the doublet, and the quotient of these parameters as functions of proton energy and object distance are also found. The energy dispersion and associated parameters in regions in which the imaginary image changes to a real image (beam crossover), i.e., for values $k_1 \simeq k_2 = 7.31 \times 10^{-4}$ cm^{-2} corresponding to different lens position are examined. The energy dispersion is independent of the location of the target when the latter is 100-800 cm behind the lens doublet and is equal to 3.21×10^{-4} and 6.04×10^{-4} for these parameter values. It is shown that the customary procedure for using quadrupole lenses to focus a beam exactly on a target so as to obtain a high current leads to poor energy dispersion. (auth)

24852 DOUBLE-HUMPED ELECTRON DENSITY DISTRIBUTION IN A MICROTRON. Luganskii, L.B.; Melekhin, V.N. (Institute of Physical Problems, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Tech. Phys. 18: No. 9, 1231-1234 (Mar 1974).

The radial structure of the electron bunches in a microtron is measured and calculated. The double-humped electron-density distribution mentioned by Bykov is only observed in a narrow range of equilibrium phases φ_s near the value corresponding to the maximum accelerated current, φ_0. Results found from a nonlinear theory of the phase motion can explain the stratification effect. (auth)

24853 TRANSVERSE COULOMB REPULSION OF PARTICLES IN AN ACCELERATOR WITH ASYMMETRIC VARIABLE-PHASE FOCUSING. Dreval', I.D.; Kushin, V.V.; Mokhov, V.M. Sov. Phys.–Tech. Phys. 18: No. 9, 1229-1230 (Mar 1974).

Because of the reduction in the focusing force with increasing particle energy in asymmetric variable-phase focusing, transverse repulsion during the later stages of acceleration becomes more important than has been assumed previously. An analysis is made of the additional limitations imposed on the magnitude of the accelerated proton current in the case of slow phase oscillations, under the assumption that the bunches are uniformly charged ellipsoids pulsating at the focusing period. The analytic functions show that with these additional restrictions (due to the transverse repulsion) it is necessary to assume the proton energy to be 100 meV. Nevertheless, in practice, a gradual reduction of the focusing force along the accelerator does not prevent the acceleration of currents of 100 mA or higher at energies up to 100 MeV. (auth)

Storage Rings

24854 CAVITY RESONATORS FOR A 3 GeV DOUBLE-RING STORAGE FACILITY. Gerke, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Quarz, W. (Kabel- und Metallwerke Gutehoffnungshuette A. G., Windeck (F. R. Germany)). Kerntechnik; 16: No. 6, 246-251(Jun 1974). (In English, German).

7 figs.

The DESY double-ring storage facility is equipped with 12 cavity resonators for each beam. The electric field generated in these resonators supplies to the particles enough energy to balance the energy lost by radiation. The cavity resonators must be manufactured of ultra-pure copper (minimum Cu content 99.997%) with the highest possible electric and thermal conductivity. They were manufactured by two different electroforming techniques. These techniques are described in detail. (auth)

Experimental Facilities

Refer also to abstract 25715.

24855 (AD-775589/5) AUTO-MODULATION OF AN INTENSE RELATIVISTIC ELECTRON BEAM. Final Report on Phase 1. Friedman, M. (Naval Research Lab., Washington, D. C. (USA)). Jan 1974. 10p. (NRL-MR-2708). NTIS $3.00.

A novel method of auto-modulating an intense relativistic electron beam has been demonstrated. The modulation is accomplished by passing the electron beam through a series of cavities that are inserted into a conventional drift tube. Experimental results indicate that the current is modulated at a frequency of 500 MHz at a relative modulation amplitude exceeding 80%. (auth)

24856 (EUR-4754) BEAM SWEEPING SYSTEM FOR A 100-keV ION ACCELERATOR. Benoit, R.; Melandrone, G. (Commission of the European Communities, Brussels (Belgium)). 1971. 18p. INIS.

In order to obtain uniform ion implantation the beam has to be swept in the XY-plane over the whole target area to be implanted. The electrostatic deflection assembly used in the 100-keV ion accelerator built at Ispra is presented. A detailed description of the completely transistorized triangular wave generator with 2×1000 V peak to peak output is given. (INIS)

24857 (IFVE-SEF-72-23) MANUFACTURING TECHNIQUE OF ATTACHMENTS FOR LIQUID HYDROGEN TARGETS OF MYLAR FILM. Vasil'ev, L. M.; Dmitrevskii, Yu. P.; Mel'nik, Yu. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 19p. (In Russian). INIS.

The technology of preparing working volumes of liquid-hydrogen targets 80 to 100 mm dia and 1 m long from Lawson films is described. They are used in experiments on the beam from the 70-GeV accelerator (IFVE). An adhesive based on epoxy resin ED-5 is used for making the attachments. The rupture pressure of the targets at 77°K was more than 4 atm. (tr-auth)

24858 (JAERI-M-5523) PULSE NEUTRON GENERATION (PULSE WIDTH OVER 0.5 μSEC) WITH JAERI 2 MV V.d.G. Tsukihashi, Y.; Takekoshi, E. (Japan Atomic Energy Research Inst., Tokyo). Jan 1974. 22p. (In Japanese). NTIS (US Sales Only).

Experimental apparatus for pulsed neutron generation (pulse width over 0.5 μsec), which has been used with the JAERI 2 MV Van de Graaff, are described. Pulsed neutrons were generated from pulsed proton or deuteron beams, in which the ratio of any residual beam intensity between bursts to the main beam intensity within a burst was below 5×10^{-8}. Detail technical representation and the results are given in each item. In addition, searches for fissioning isomers with 14.8 MeV pulsed neutrons are briefly mentioned. (auth)

24859 A VELOCITY FILTER FOR HEAVY-ION REACTION PRODUCTS. Ewald, H.; Guettner, K.; Hinckel, P.; Muenzenberg, G. (Giessen Univ. (F. R. Germany). 2. Physikalisches Inst.); Faust, W.; Nickel, F. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)). Kerntechnik; 16: No. 6, 237-245(Jun 1974). (In German, English).

14 figs.; 2 tabs.; 18 refs.

A velocity filter for high energy nuclear reaction products is under construction in Wixhausen near Darmstadt for the heavy-ion accelerator. By means of this filter the projectiles passing on in the beam direction behind thin targets (thicknesses about 1 μm) are to be separated from the reaction products produced and partly also moving in this direction. The mode of operation and design of the separator are described. (auth)

24860 POLARIZED TARGETS. Kuiper, H. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Physikalisches Inst.). Kerntechnik; 16: No. 6, 252-259(Jun 1974). (In German, English).

1 fig.; 1 tab.; 31 refs.

Polarized targets are highly developed special devices increasingly used in recent years in nuclear and especially in high energy physics experiments. A brief review of the methods used for the implementation of polarized targets is given. The technology of polarized proton targets is discussed in greater detail because these targets are already widely used. (auth)

24861 PRODUCTION OF A MONOCHROMATIC, LOW ENERGY POSITRON BEAM USING THE $^{11}B(p,n)^{11}C$ REACTION. Stein, T.S.; Kauppila, W.E.; Roellig, L.O. (Wayne State University, Detroit, Michigan 48202). Rev. Sci. Instrum. 45: No. 7, 951-953 (July 1974).

A new technique has been developed to produce an intense positron source by making use of the $^{11}B(p,n)^{11}C$ reaction. Positrons with well-defined low energies have been observed emerging from the irradiated boron target itself without any additional moderating materials. A description of the apparatus used to produce the ^{11}C and to detect the low energy positrons is given. (auth)

24862 INSTALLATION, FOCUSING, CALIBRATION, AND OPERATION OF A MATTAUCH–ELBEK SPECTROGRAPH. Mazari, M. (Univ. Nacional de Mexico, Mexico City); Roos, R.; Aldape, F.; Olmos, D.; Palacios, N.; Godinez, E.; Dacal, A.; de Lopes, M. E. O. Rev. Mex. Fis., Suppl. Fis. Apl.; 22: FA17-FA26. (1973). (In Spanish).

The operation and certain characteristics of a Mattauch–Elbek type spectrograph coupled to a tandem Van de Graaff accelerator at the Mexican Nuclear Center are given. These include: details of the vacuum system incorporating the pole pieces, particle focusing, calibration, track range-energy diagrams, background reduction, beam slit box, magnetization curve, and second scattering system. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstract 24088.

24863 (AD-737848) MODULATION EFFECTS IN THE COSMIC-RAY INTENSITY AND THEIR DEPENDENCE ON SUN-SPOT NUMBER, 10.7-cm RADIO FLUX, AND GEOMAGNETIC ACTIVITY. Ruthberg, S.; Wahab, S. A. (Uppsala Univ. (Sweden). Fysiska Institutionen). 15 Jun 1971. Contract P61052-68-C-0034. 23p. (UU/CRG-71-3; AFCRL-71-540). NTIS $3.00.

The 27-day recurrency in the galactic cosmic ray intensity and its dependence on sunspot number, 10.7 cm radio flux and geomagnetic activity has been studied through the years 1958-1969. In 1966-67 a strong periodic correction is found between the solar activity and the cosmic ray intensity. The geomagnetic activity and the cosmic ray intensity are found to be strongly related both at solar maximum and solar minimum of activity. (auth)

24864 (AD-775862/6) ANOMALOUS COSMIC-RAY ANISOTROPY AND UNIDIRECTIONAL INTERPLANETARY MAGNETIC FIELD DURING 1954. Atonucci, E. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Sep 1973. Contract N00014-67-A-0112-0068. 20p. (SU-IPR-542). NTIS $3.00.

Observations of the interplanetary magnetic field during solar minimum lead to the following important conclusions for cosmic ray modulation: (A) the interplanetary magnetic field does not show any sector structure for a few solar rotations, i.e. the field has polarity away from the sun during this interval, (B) cosmic ray diffusion in the interplanetary medium is essentially anisotropic for rigidity of the order of 10 GV (k parallel/k perpendicular approximately 0.01 ratio of diffusion coefficients calculated from the magnetic-field power spectra by Jokipii and Coleman). If diffusion occurs essentially along the magnetic field lines, the cosmic ray density u(r, t) is a symmetric function of the heliolatitude lambda with a minimum in the equatorial plane: u(r,t, lambda) proportional to $A^{-B\cos^2(\lambda)}$. Therefore a cosmic ray density gradient across the solar equatorial plane exists and it depends on the size of the modulation region. (auth)

24865 (GSI-tr-74/6) TRACK DETECTION OF HEAVY NUCLEI FROM THE PRIMARY COSMIC RADIATION IN METEORITIC MINERALS. Otgonsuren, O.; Perelygin, V. P. Feb 1974. Translation of JINR-P-7-7406. 17p. (In German). INIS.

The problems of the detection of long tracks of superheavy cosmic nuclei in olivine crystals of meteorites, and how they can be identified are discussed. The investigation of the sensitivity of olivines towards heavy charged particles has led to the detection of a regression effect under space conditons in the tracks of olivines from the meteorites Lipovsky Khutor and Maryalahti. The upper limit of intensity of cosmic nuclei with $Z \geq 70$ in crystals of these meteorites has been found to be $3-5 \times 10^{-7}$ relative to nuclei of the iron group. (auth)

24866 (INS-TCA-30) DETECTION OF COSMIC RAY PRODUCED RADIONUCLIDES BY MEANS OF A LOW BACKGROUND COUNTING SYSTEM. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 29 Nov 1973. 45p. (In Japanese). INIS.

In a previous report various problems in the detection project of the cosmic ray produced radionuclides contained in extraterrestrial dusts accreted on the Earth were discussed. In the first stage it is proposed to construct a large well-type NaI(Tl) scintillator and a 4 π-GM counter system for β-γ countings. In part I the results are described about radioactive impurities contained in the component materials of the detector system. The automatical gain control system and the pulseshape discrimination technique are also discussed. In part II a general survey of a fast electronics is carried out and special problems for low-level radiation measurements are pointed out. (auth)

24867 (JPRS-62553, pp 1-6) DOSIMETRIC INVESTIGATIONS ABOARD THE SALYUT ORBITAL SPACE STATION. Red'ko, V. I.; Kozlova, S. B.; Markelov, V. V.; Stepanov, A. S.; Chernykh, I. V. 24 Jul 1974. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 3-6(1974).

Dosimetric measurements of cosmic radiation carried out aboard the "Salyut" orbital station using apparatus consisting of a telescope and two semiconductor detectors are summarized. The apparatus recorded fluxes of charged particles in several energy ranges and measured the linear energy transfer of these particles. The apparatus also included a tissue-equivalent ionization chamber for ascertaining the absorbed dose. According to experimental data, the dose rate of the absorbed dose was 11 mrad/day, the dose rate of the equivalent dose was 13.4 mrem/day, and the mean quality factor was 1.2. High-energy protons made the principal contribution to the dose ($E_p > 140$ MeV). This suggests that the distribution of the dose field within the station was more or less uniform. (auth)

24868 (N-73-18811) RELATIVISTIC HEAVY COSMIC RAYS. Mewaldt, R. A.; Fernandez, J. I.; Israel, M. H.; Klarmann, J.; Binns, W. R. (Washington Univ., St. Louis, Mo. (USA)). 1972. 45p. (NASA-CR-130921). NTIS $4.25.

During three balloon flights of a 1 sq m sr ionization chamber/Cherenkov counter detector system, measurements were made of the atmospheric attenuation, flux, and charge composition of cosmic ray nuclei with 16 is $\leq Z$ is ≤ 30 and rigidity greater than 4.5 GV. The attenuation mean free path in air of VH ($20 \leq Z \leq 30$) nuclei is found to be 19.7 ± 1.6 g/sq cm, a value somewhat greater than the best previous measurement. The attenuation mean free path of iron is found to be 15.6 ± 2.2 g/sq cm, consistent with predictions of geometric cross-section formulae. An absolute flux of VH nuclei 10 to 20% higher than earlier experiments at similar geomagnetic cutoff and level of solar activity was measured. The relative abundances of even-charged nuclei are found to be in good agreement with results of other recent high resolution counter experiments. The observed cosmic ray chemical composition implies relative abundances at the cosmic ray source of $Ca/Fe = 0.12 \pm 0.04$ and $S/Fe = 0.14 \pm 0.05$. (auth)

24869 ^{40}Ar-^{39}Ar CHRONOLOGY AND COSMIC RAY EXPOSURE AGES OF THE APOLLO 15 SAMPLES. Husain, L. (Department of Earth and Space Sciences, State University of New York, Stony Brook, New York 11790). J. Geophys. Res. 79: No. 17, 2588-2606 (10 June 1974).

Crystallization ages have been determined for a suite of lunar samples from seven stations at the Apollo 15 landing site. The samples include five large crystalline rocks, seven rake basalts, and thirteen 2-to 4-mm igneous and two breccia fragments. All four major petrographic rock types observed in Apollo 15 collection were represented. The $^{40}Ar^*/^{39}Ar^*$ release patterns of the 2- and 4-mm fragments are as well defined as those of large rocks and rake basalts. Shock effects in the 2- to 4-mm fragments were studied. Shock deformations of up to moderate strength have little or no effect on either the $^{40}Ar^*/^{39}Ar^*$ thermal release patterns or the extent of the $^{40}Ar^*$ diffusion. Rocks 15058, 15499, and 15555 have ages of 3.358 ± 0.025, 3.34 ± 0.08, and 3.34 ± 0.04 Gy. Six of the seven rake basalts have ages between 3.26 and 3.39 Gy. It is concluded that the peak of the magmatic activity in Palus Putredinis occurred at 3.33 ± 0.02 Gy. The younger ages of 3.13 ± 0.06, 3.16 ± 0.05, and 3.20 ± 0.07 Gy for three igneous samples were also determined, indicating that the magmatic activity continued up to about 3.13 Gy, though at a reduced level. No rock younger than 3.13 Gy was found. The period of igneous activity determined here for Palus Putredinis is very similar to that for Oceanus Procellarum. It appears that the period of igneous activity in lunar maria is typically about 200 m.y. No correlation between the petrographic rock types and the crystallization ages was observed. Potassium and calcium contents of basalts average about 350 ppm and 6%, respectively. No significant differences in the K contents of the four petrographic rock types were observed. About 90% of the 2- to 4-mm fragments from soil at St. George crater and the Apennine Front are brown glass microbreccias. These fragments contain large amounts of trapped ^{40}Ar, making accurate age measurements impossible. An age for a recrystallized breccia was measured to be 3.93 ± 0.08 Gy. An Imbrium impact origin for this breccia fragment is suggested. The cosmic ray exposure ages of all the samples were measured by using correlation plots of $^{38}Ar^*/^{37}Ar$ and $^{40}Ar^*/^{39}Ar^*$. Large rocks (15058, 15415, 15499, and 15555) have exposure ages of between 80 and 135 m.y. Most rake samples and 2- to 4-mm fragments have exposure ages of between 200 and 500 m.y. No grouping of exposure ages for samples from any of the stations at the Apollo 15 site was observed, suggesting intense lunar gardening in this region. It is concluded that the exposure ages of Apollo 15 rocks cannot reliably be used to date the prominent cratering events at this site. (auth)

24870 SAS-2 OBSERVATIONS OF THE HIGH-ENERGY GAMMA RADIATION FROM THE VELA REGION. Thompson, D.J.; Bignami, G.F.; Fichtel, C.E.; Kniffen, D.A. (NASA/Goddard Space Flight Center, Greenbelt, Maryland 20771). Astrophys. J. Lett. 190: No. 2, L51-L53 (1 June 1974).

Data from a scan of the galactic plane by the SAS-2 high-energy ($E > 30$ MeV) γ-ray experiment in the region $250° < l^{II} < 290°$ show a statistically significant (7 σ) excess over the general radiation from the galactic plane for γ-radiation of energy greater than 100 MeV in the region $260° < l^{II} < 270°$ and $-7.5 < b^{II} < 0°$. If the enhanced γ-radiation

results from interactions of cosmic rays with galactic matter, as the energy spectrum suggests, it seems reasonable to associate the enhancement with large-scale galactic features, such as spiral-arm segments in that direction, or with the region surrounding the Vela supernova remnant, with which PSR 0833—45 is associated. If the excess is attributed to cosmic rays released from this supernova interacting with the interstellar matter in that region, then on the order of 3×10^{50} ergs would have been released by that supernova in the form of cosmic rays. (auth)

24871 AN INTERPRETATION OF THE OBSERVED OXYGEN AND NITROGEN ENHANCEMENTS IN LOW-ENERGY COSMIC RAYS. Fisk, L.A.; Kozlovsky, B.; Ramaty, R. (Laboratory for High Energy Astrophysics, Goddard Space Flight Center, Greenbelt, Maryland, 20771). Astrophys. J. Lett. 190: No. 1, L35-L37 (15 May 1974).

It is proposed that the enhancements of cosmic-ray oxygen and nitrogen observed at ~10 MeV per nucleon could result from neutral interstellar particles which are swept into the solar cavity by the motion of the Sun through the interstellar medium, and which are subsequently ionized and accelerated. (auth)

24872 ANOMALOUS MUON AND HADRON CHARGE RATIOS IN SECONDARY COSMIC RAYS. Adair, R.K. (Yale University, New Haven, Connecticut 06520). Phys. Rev. Lett. 33: No. 2, 115-119 (8 July 1974).

Secondary cosmic-ray muon and hadron fluxes are calculated for particle energies above 200 GeV using accelerator data on inclusive hadron cross sections and the known primary flux. The gross differences between the calculated and measured muon and hadron charge ratios require radical reexamination of conventional views on hadron interactions or the neutron-proton ratio in the primary flux. (auth)

24873 MEASUREMENT OF THE POSITRON-ELECTRON RATIO IN THE PRIMARY COSMIC RAYS FROM 5 TO 50 GeV. Buffington, A.; Orth, C.D.; Smoot, G.F. (Space Sciences Laboratory and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 33: No. 1, 34-37 (1 July 1974).

We report the first measurement of primary-cosmic-ray positrons above 5 GeV. Both e^+ and e^- fluxes were measured, using a balloon-borne magnetic spectrometer. Background was suppressed using a new technique which combines both selective trigger and identification of bremsstrahlung photons created by $e^\pm$ upon entering the instrument. If no positrons originate at cosmic-ray sources, our observed ratio $e^+/(e^++e^-) = 0.08 \pm 0.02$ requires source protons to traverse 3.5 ± 1.5 g/cm^2 of interstellar material. (auth)

24874 THE RESPONSE OF THE DEEP RIVER NEUTRON MONITOR TO AN ANISOTROPIC FLUX OF SOLAR COSMIC RAYS. Shea, M.A.; Smart, D.F. (Air Force Cambridge Research Laboratories, L. G. Hanscom Field, Bedford, Massachusetts 01730). J. Geophys. Res. 79: No. 16, 2487-2490 (1 June 1974).

The response of a neutron monitor to an anisotropic flux of solar cosmic rays is a function of the viewing direction of the detector through the magnetosphere, as defined by the asymptotic cone of acceptance, and the direction of the solar cosmic ray flux anisotropy. Since the Deep River, Canada, neutron monitor data are used extensively for monitoring the cosmic radiation intensity and are often used as a standard in the analyses of cosmic ray data, we have calculated the response of this monitor throughout the day to a high-energy (>450 MeV) anisotropic solar cosmic ray event propagating along the ecliptic plane. This technique can be applied to any groundbased neutron monitor. (auth)

24875 HIGH-ENERGY COSMIC RAY INTENSITY INCREASE OF NONSOLAR ORIGIN AND THE UNUSUAL FORBUSH DECREASE OF AUGUST 1972. Agrawal, S.P.; Ananth, A.G.; Bemalkhedkar, M.M.; Kargathra, L.V.; Rao, U.R. (Physical Research Laboratory, Ahmedabad, India); Razdan, H. J. Geophys. Res. 79: No. 16, 2269-2280 (1 June 1974).

A series of spectacular cosmic ray events, which included two relativistic solar particle enhancements and three major Forbush decreases, was registered by ground-based cosmic ray monitors beginning on August 4, 1972. Among these, the Forbush decrease that occurred on August 4-5 exhibited extremely interesting and complex behavior, the prominent features of which are a preincrease (PI-1) prior to the largest Forbush decrease (FD-2) during the recovery of which an abrupt universal time increase (PI-2) occurred. Large N-S and E-W anisotropies were observed during the entire Forbush decrease event. The rigidity spectra for both FD-2 and PI-2 had pratically the same exponent of -1.2 ± 0.2 and an upper cutoff rigidity of about 50-60 GV, and the anisotropy during both PI-1 and PI-2 was from the sunward direction. This paper describes the detailed observational features and presents a unified model to explain these in terms of a transient modulating region associated with the passage of a shock front. In this model, the reflection of particles from the approaching shock front accounts for the preincrease (PI-1), whereas the early onset of FD-2 from the antisun direction is caused by the occultation of particle trajectories reaching the earth from that direction while the detectors looking along the sunward direction are still sampling albedo particles reflected from the shock front. The main Forbush decrease occurs as the shock front, containing tangled magnetic fields with large-scale tangential discontinuities, sweeps past the earth. The particles, diffusing into the cavity as they are swept by the solar wind, get 'piled up' behind the tangled region causing the abrupt increase (PI-2). Evidence from interplanetary plasma, radio, and field measurements is provided in support of the model wherever possible. (auth)

24876 CALCULATION OF MUON YIELDS, RESPONSE FUNCTIONS, AND SEA LEVEL INTEGRAL ENERGY SPECTRUM USING RECENT ACCELERATOR DATA AND FEYNMAN SCALING. Gaisser, T.K. (Bartol Research Foundation of The Franklin Institute, Swarthmore, Pennsylvania 19081). J. Geophys. Res. 79: No. 16, 2281-2286 (1 June 1974).

We calculate the number of muons of energy greater than E_μ due to a primary nucleon of energy E_0 for $E_\mu \gtrsim 10$ GeV. The yields have been calculated (assuming normal parentage for the muons) by solving the atmospheric diffusion equation governing the pion flux in the atmosphere and determining the corresponding muon production spectrum and hence the muon yields. This method assures that muons from pions many generations removed from the primary are included and, in addition, takes account of the effect of pion decay on the multiplication of the pion flux in the atmosphere. The basic input to the equation is the inclusive cross sections for the processes $pp\to\pi^\pm+$(anything) and $\pi p\to\pi+$(anything) as determined from recent accelerator data (including intersecting storage ring (ISR) data for proton-proton (pp) interactions). These production spectra are extrapolated as necessary by use of the Feynman scaling hypothesis. We find a median primary energy ranging from about $15E_\mu$ at $E_\mu\sim10$ GeV to about $11E_\mu$ at $E_\mu\sim1000$ GeV. The derived sea level integral muon energy spectrum is in good agreement with the observed spectrum. (auth)

24877 ENERGETIC PARTICLES FROM THE SUN. Sakurai, K. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Astrophys. Space Sci.; 28: No. 2, 375-519(Jun 1974).

619 refs.

This paper discusses solar cosmic ray phenomena and related topics from the solar physical point of view. Basic physics of the solar atmosphere and solar flare phenomena are, therefore, considered in some detail. Since solar cosmic rays are usually produced by solar flares, we must first understand the processes and mechanism of solar flares, especially the so-called proton flares, in order to understand the acceleration mechanism of solar cosmic rays and their behavior in both the solar atmosphere and interplanetary space. For this reason, detailed discussion is given on various phenomena associated with solar flares, proton flare characteristics, and the mechanism of solar flares. Since the discovery of solar cosmic rays by Forbush, the interplanetary space has been thought of as medium in which solar cosmic rays propagate. The propagation of solar cosmic rays in this space is, therefore, discussed briefly by referring to the observed magnetic properties of this space. Finally, some problems related to the physics of galactic cosmic rays are discussed. (auth)

24878 TIME CORRELATION OF HEAVY COSMIC RAY NUCLEI. Walker, S. E. Riverside, CA; Univ. of California (1973). 101p. University Microfilms Order No. 74-13,582.

Thesis (Ph.D.).

The time correlation of heavy cosmic ray nuclei over a 4.5 hour period has been investigated. The results were obtained from a balloon flight from Ft. Churchill, Manitoba, 73° North geomagnetic latitude, on July 22, 1972. Identifying the charge and kinetic energy/nucleon of incident, heavy cosmic ray nuclei by 4 simultaneous dE/dx measurements and an active time of flight measurement, a detector was lifted by balloon to the top of the atmosphere where only 0.4% of residual atmosphere remained. During the 19 hours at float altitude, a continuous 4.5 hours were allocated to the heavy nuclei experiment. The magnitude of the galactic, heavy nuclei flux is perturbed during solar activity. This activity produces magnetic field irregularities that propagate outward with the solar plasma and act as scattering centers for the incident galactic particles. With the high event rate capability of the particle spectrometer, the results of the time correlation showed no statistically significant evidence of small perturbations from the average intensity for the incident heavy nuclei with kinetic energies >350 MeV/nucleon over the 4.5 hour exposure period. Minimal solar activity from July 17 through July 23 of 1972 supports this result. In addition, no evidence of a direct diurnal anisotropy consistent with the corotation of galactic heavy nuclei with the solar magnetic field was ob-

served. As a consequence of the symmetry and size of the detector, a search for a heavy nuclei component of the splash albedo was undertaken. Restricting the analysis to those events with a time of flight corresponding to an upward moving particle with kinetic energy >350 MeV/nucleon, the data recorded during the 4.5 hour exposure period showed no evidence of a heavy nuclei contribution to the splash albedo flux. (Diss. Abstr. Int., B)

24879 EFFEKTIVNYE ZHESTKOSTI OBREZANIYA KOSMICHESKIKH LUCHEI. (Cosmic Rays Effective Cut-Off Rigidities). Dorman, L. I.; Gushchina, R. T.; Shea, M. A.; Smart, D. F. Moscow; Izdatel'stvo Nauka (1972). 153p.

The results of calculations of cosmic ray effective cut-off rigidities in real magnetic field are given. Use is made of the results of trajectory calculations of the penumbra function. The results of the effective cut-off calculations are presented for the whole network of cosmic ray stations in the USSR and abroad and for expedition studies. The tables are also presented which determine the dependence of effective cut-off rigidities on the type of detectors and their variations as expected for various cosmic ray variations. (2 figures, 128 tables, 13 references) (auth)

24880 PROJECT OF STUDY ON SUPER HEAVY NUCLEI IN COSMIC RAYS. Preliminary Report. Okamoto, H. (Waseda Univ., Tokyo); Shibamura, E.; Saito, T.; Yanagimachi, T. Uchusen Kenkyu; 17: No. 4, 504-525(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamamatsu, Japan (Dec 1971).

The purpose of the present project is to study the proportion of production of elements in space as cosmic ray. The objects of the study are the charge spectra of cosmic ray, the mechanism of acceleration and the mechanism of propagation. The charge spectra were considered by dividing into Z regions of Z = 26 ~ 83 (s-process termination), transbismuth (γ-process), and transuranium (especially Z ≅ 110). The experiment in 1971 was performed as a preliminary experiment for putting in practical use of nuclear charge discrimination technique for cosmic ray. The nuclear charge can be determined by measuring etching rate V_T. The present experiment aimed at testing the discrimination technique for nuclear charge with X-ray films, measuring the charge spectra of iron (Z ~ 26), putting in practical use the discrimination technique for relativistic and non-relativistic charged particles with highly sensitive x-ray films, determining $V_T - Z$ calibration curves by cellulose-tri-acetate (C. T. A. Fuji) and poly-carbonate (P. C. Teijin), and testing the practical use of position detectors. The size of P I for balloon flight was 10 m^2. The flight was performed on September 16, 1966 for about 8 hours. Calibration of detectors was made by C beam from a cyclotron. It was found that the detection of iron in primary cosmic ray was possible with X-ray films. The measurement of charge by emulsion, and comparison of emulsion with X-ray films were performed. The test of pinhole detectors as position detectors and the calibration of the position detectors with fission fragments were carried out. (JA)

24881 SHORT PERIOD VARIATION OF COSMIC RAY INTENSITY. Mori, S. (Shinshu Univ., Matsumoto, Japan). Uchusen Kenkyu; 18: No. 1, 61-70(Aug 1973). (In Japanese).

Short period variation of cosmic ray intensity was investigated by analyzing the data obtained at Mt. Norikura for the period of Aug.-Oct., 1971. The analysis was performed by the well-known power spectrum analysis. Self-correlation function, the raw estimate of power density and the final estimate by Hanning were calculated. The frequency (f) dependence of the power spectral density P (f) was shown as $f^{-1.7}$ for the frequency range between 10^{-5} and 10^{-3} Hz. The value of γ, which is the exponent of $f^{-\gamma}$ dependence, decreases at high frequency, and this fact can be explained by considering white noise level. Peaks of the power density at any specified frequency can not be observed. The bound level value of power density was calculated by random number simulation, and good agreement was seen between expected value and observed value for the data of mesons. The observed value of neutrons was larger than the expected value. This fact shows the small number of effective count. Reduction factor K^2 or K was obtained, and the value of K was 1.7 ~ 1.9. It can be examined whether the data varies according to Poisson distribution by comparing the observed value of bound level with the expected value. (JA)

24882 THEORY OF ACCELERATION. Mukai, T. (Kyoto Univ.). Uchusen Kenkyu; 17: No. 4, 545-549(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamamatsu, Japan (Dec 1971).

A theory of the acceleration of particles in space is discussed. The phenomenological approach is to consider local sources as acceleration sources which are shown in this paper schematically. Problems to be studied are the efficiency of energy transfer from the accumulated energy in sources to cosmic ray energy, region of acceleration, and formation of energy spectra. The sources of accumulated energy may be the kinetic energy of turbulent flow and the energy of magnetic field. The threshold velocity of escaping cosmic ray and the interaction between plasma and the flow of cosmic ray should be considered for the energy transfer. For energy spectra, several spectra are proposed from the theory of radiation. The energy spectra in the region of acceleration and deformation of the spectra are investigated. (JA)

24883 OBSERVATION OF PARALLEL MUONS 1350 HG/CM^2 UNDERGROUND. Suda, T.; Totsuka, Y.; Koshiba, M. (Tokyo Univ.). J. Phys. Soc. Jap.; 36: No. 2, 351-360(Feb 1974).

An experiment was carried out at vertical depths of 1350 hg/cm^2 underground in order to investigate the high energy, ≥450 GeV, muon bundles. The muon bundles, up to the highest observed multiplicity of 18, were observed in a stack of three horizontal layers of wide gap spark chambers and three lead absorber layers of area 8.35 m^2 each. The experimental set-ups and the procedures in correcting for various experimental biases are described. The result for the average zenith angle of 20° and the average slant depth of 1380 hg/cm^2 in standard rock is presented in the form of multiplicity distribution. (auth)

24884 PROBABLE ORIGIN OF CARBONACEOUS CHONDRITES. Fesenkov, V. G. Meteoritika; No. 32, 3-6(1973). (In Russian).

Theoretical considerations are given in support of the hypothesis that collisions of comet-like inhomogeneities in interstellar matter may have produced the short-lived local heating events which were necessary for the formation of complex organic compounds later incorporated in the material of carbonaceous chondrites. The presence of short-lived isotope decay products in meteorites is interpreted as an indication that a supernova explosion may have taken place in the early phase of the solar system shortly before the formation of the planets. It is suggested that such an explosion might have promoted the formation of comet-like inhomogeneities in the protoplanetary nebula at that time. (IAA)

24885 METEORITE CLASSIFICATION AND ITS SIGNIFICANCE FOR THE PROBLEM OF METEORITE ORIGIN. Lavnel, A. A. (Komitet po Meteoritam, Moscow). Meteoritika; No. 32, 25-36(1973). (In Russian).

The author's classification of meteorites proposed in 1958 is revised and augmented by data of the following 15 years, with substantial refinement and extension of the iron meteorite and chondrite classification. A modified classification of chondrites according to chemical and petrological characteristics is also proposed. An attempt is made to establish genetic relations between different meteorite classes. (IAA)

24886 SEARCHES FOR FINELY DISPERSED COSMIC MATERIAL IN TURFS OF THE TUNGUSKA METEORITE FALL AREA. Vasil'ev, N. V.; L'vov, A.; Vronskii, B. I.; Grishin, A.; Ivanova, G. M.; Meniavtseva, T. A.; Griaznova, S. N.; Baulin, P. P. (Komissiia po Meteoritam i Kosmicheskoi, Pyli, USSR). Meteoritika; No. 32, 141-146(1973). (In Russian).

24887 THREE DIMENSIONAL ANISOTROPY OF COSMIC RAY AND INTERPLANETARY SPACE MAGNETIC FIELD. Hujimoto, K. (Univ., Nagoya, Japan). Uchusen Kenkyu; 18: No. 1, 113-118(Aug 1973). (In Japanese).

It has been known that the origin of the half-a-day variation of cosmic ray is symmetric regarding a reference axis, and shows loss cone distribution. The investigation into the growth and decay of the loss cone may give the information concerning the status of interplanetary space. For this purpose, the rotation average data (Nov. 1968–July 1971) of the multi-direction meson detector at Mt. Norikura was analyzed. The direction and magnitude of the reference axis of the loss cone distribution of cosmic ray was determined by the least square method. The magnitude of 1st and 2nd terms η_1 and η_2 determined for each rotation are shown. It was found that the intensity of cosmic ray vertical to the reference axis was strong, and the directional distribution with axial loss was reconfirmed. Variation of the direction of reference axis of anisotropy shows that solar ecliptic latitude moved to south in 1970, and returned to the ecliptic plane afterwards. Difference according to rotation was seen in the rigidity spectra of the loss cone distribution, but the majority show $\gamma P_0 = 100$ GV. The rotation average direction of magnetic force line moved to south in 1970. (JA)

24888 MEASUREMENT OF THE ENERGY SPECTRUM OF ELECTRONS OF 0.25 TO 24 keV AT HEIGHTS OF 80 TO 170 km AT MIDDLE LATITUDES ON OCTOBER 21, 1970. Antonova,

L. A.; Ivanov-Kholodnil, G. S.; Medvedev, V. S. Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 712-714(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 840-843(1973).

The differential energy spectra of electrons in the 0.5- to 24-keV range were measured in the midlatitude upper atmosphere at heights of 80 to 170 km. The flux of electrons with $E \lesssim 1$ keV has high intensities at 80 to 170 km. It is concluded that local electron acceleration is possible at relatively small heights in the upper atmosphere. (auth)

24889 SPECTRUM OF SOFT-COMPONENT ELECTRONS AT SEA LEVEL. Pugacheva, G. I.; Yamburenko, N. S. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 778-779(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 918-919(1973).

A modified telescope was used to measure the electron flux with $E_e > 80$ MeV as 10 m^{-2} sec^{-1} $ster^{-1}$ at sea level. This amounts to 11% of the flux of muons at sea level. (JFP)

Stars

Refer also to abstracts 24981, 25067, 25595, 25709, 25712, and 25803.

24890 (UCRL-51552) NUMERICAL STUDY OF PROTO-STELLAR FORMATION. Westbrook, C. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Mar 1974. Contract W-7405-Eng-48. 93p. Dep. NTIS $7.75.

Thesis.

The earliest phase in the evolution of a star is the formation of a gravitationally bound gas cloud from the interstellar medium. This cloud mass is not, in general, in hydrostatic equilibrium, and will evolve hydrodynamically until equilibrium is attained. The protostellar evolution of these gas clouds is examined. A mathematical model is presented treating all the appropriate physical processes which are important during protostar formation including hydrodynamics, thermodynamics and equation of state, radiation transport, and convective energy transport. Important features of the mathematical model are use of temperature or specific energy density as an independent parameter rather than energy flux or luminosity and inclusion of all time derivatives from the differential equations. These provisions cast the stellar structure equations into the form of an initial-value problem that can be evolved in time. A numerical model is then developed. An important feature of the difference equations is their ability to evolve configurations which are far from radiative, convective, or hydrodynamic equilibrium. This feature is a direct result of the form presented for the differential equations. This numerical model is applied to a wide range of initial conditions. The evolution of cloud masses from 0.01 to 50 solar masses is investigated. Results of evolutionary calculations are presented which are consistent with the existence of a lower mass limit for formation of main sequence stars. Other results for large mass clouds demonstrate mechanisms which severely limit the maximum size for stable stars. Calculations for protostars of one solar mass are compared with calculations in the astrophysical literature, and indicate that such a protostar first appears as a stellar object with an effective temperature of about 3100°K and a luminosity of about 500 times that of the sun. All the calculations included assume spherical symmetry. Convective energy transport is treated with mixing length theory which has been extended to deal with conditions far from convective equilibrium by the introduction of a convective flux limiter. A numerical model is developed for material in hydrostatic equilibrium, with radiative and convective energy transport, coupling implicitly all the stellar structure equations into one system. This system of numerical equations is then joined when necessary to the decoupled hydrodynamics and energy balance equations at the boundary of the region which is in hydrostatic equilibrium. All of these numerical models allow the evolution to be followed far beyond the stage where previous calculations in the literature had to be terminated. These calculations are, therefore, able to include the entire evolution of a protostar from its formation until well into the quasi-static contraction phase in a single consistent numerical treatment. (17 figures, 12 tables) (auth)

24891 PLASMON EMISSION BY AN ATOM IN A MAGNETOACTIVE PLASMA. Kleiman, E.B.; Oiringel', I.M. (Institute of Terrestrial Magnetism, the Inosphere, and Radio-Wave Propagation, Siberian Branch, Academy of Sciences of the USSR). Sov. Astron.-AJ 50: No. 4, 560-561 (Jan 1974).

Probabilities are calculated for the emission of transverse and longitudinal plasmons by an atom in a magnetoactive plasma medium ($\omega_p e > \omega He$). Longitudinal plasmons can be emitted more efficiently than transverse plasmons. (auth)

24892 UNIQUENESS OF THE LIGHT-CURVE SOLUTION FOR AN ECLIPSING BINARY HAVING A COMPONENT WITH AN EXTENDED SPHERICAL ATMOSPHERE. Cherepashchuk, A.M. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 50: No. 4, 555-556 (Jan 1974).

A sufficiency criterion is derived for the uniqueness of the solution of the light curve for an eclipsing system in which one star has an extended spherical atmosphere. (auth)

24893 KINEMATICS OF O AND B STARS. Balakirev, A.N. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 4, 482-484 (Jan 1974).

The kinematics of type O9-B9.5 I-III stars is investigated on the basis of a radial-velocity analysis for different spectral types of locations in space; the results are tabulated. For all the stars combined, $A = 12.5 \pm 0.6$ km.sec^{-1} and $\alpha = -1.3 \pm 0.3$km.sec^{-1}.kpc^{-2}. The centroid of the stars considered rotates more slowly than the centroid of the solar neighborhood by 8.4 $\pm$1.3km/sec toward the galactic center. (auth)

24894 TRANSFER EQUATIONS FOR SPECTRAL LINES IN A MAGNETIC FIELD. Dolginov, A.Z.; Pavlov, G.G. (A. F. Ioffe Technical Physics Institute, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 4, 485-491 (Jan 1974).

Equations of transfer for atomic spectral lines in a magnetic field are derived. Possible nonequilibrium population of the magnetic sublevels in the initial state of the atom and collision of the excited atom with surrounding particles are taken into account. Various forms of the transfer equation given in the literature are special cases of our equations. (auth)

24895 CHROMOSPHERES OF COOL STARS. Katsova, M.M. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 4, 492-496 (Jan 1974).

Model chromospheres are calculated for stars of various special types. The chromosphere is assumed to be heated by slow waves, a portion of the ensemble of waves rising from the photosphere beneath. The system of equations describing the model chromosphere is reduced to an ordinary differential equation with initial conditions. Its solution provides temperature-density relations for the sun, a giant, and a dwarf. The following values are calculated for the extent of the chromosphere: For the sun, 4570 km; for G0-K5 dwarfs, $\simeq$4550-3810 km; for G0-K5 giants, $\simeq 2.06 \cdot 10^5$ to $5.98 \cdot 10^6$ km. The H II zones formed around the stars by their thermal radiation in an interstellar medium of density 1 cm^{-3} have the following radii: For the sun, 6700 a.u. or 0.03 pc; for G0-K5 dwarfs, $\simeq$0.8-0.44 pc; for G0-K5 giants, $\simeq$2.6-6.9 pc. (auth)

24896 METHOD OF DETERMINING THE MASSES OF GLOBULAR CLUSTERS. Naumova, E.V.; Ogorodnikov, K.F. (A. A. Zhdanov Leningrad State University). Sov. Astron.-AJ 17: No. 4, 463-465 (Jan 1974).

A method is proposed for determining the masses of globular clusters. It is based on the focusing of field stars when they stream past the cluster with a velocity V_0 that is large compared with the random velocities of the stars. The expressions (4) are obtained for the additional variance of the star velocities due to the focusing, whose principal component is at right angles to the axis of motion of the cluster. The theory is applied to the globular cluster ω Cen (NGC 5139), for which the proper motions of more than 4000 stars have been determined at the Greenwich Observatory. Processing of these motions gives an estimate for the mass of the cluster of the order of 10^8 $M_\odot$, which is two orders of magnitude greater than the generally adopted values. Further investigation must show whether this indicates the presence of a black hole in the center of the cluster. It would be very desirable to know the proper motions for stars at a distance of a few cluster radii from the center. (auth)

24897 EARLY-TYPE HIGH-VELOCITY STARS. III. A SEARCH FOR THE He^3 ISOTOPE. Vitrichenko, E.A.; Marsakov, V.A. (Crimean Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 4, 497-499 (Jan 1974).

Isotopic shifts of He lines have been measured for four high-velocity OB stars and one standard star, using spectrograms of 8-A/mm dispersion obtained with a grating spectrograph at the coudé focus of the 2.6-m reflector of the Crimean Astrophysical Observatory. Of the five stars examined, four exhibited no appreciable isotopic shifts. In the high-velocity star 53 Ari, three He lines do show isotopic shifts consistent with laboratory measurements; the other He lines are not shifted. Several alternative explanations of the effect are discussed. (auth)

24898 SPECTROPHOTOMETRY OF SS CYGNI. Voikhanskaya, N.F. (Special Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 4, 500-502 (Jan 1974).

Spectrophotometric gradients ϕ_1 and temperatures T_* are determined for the star SS Cyg. It is found that: 1) $T_* = 15000 \pm 2000$°K at both minimum maximum light; 2) as a flare develops the star first reddens until $m_V \simeq 10^m$, when T_* reaches a minimum of $11{,}000 \pm 1000$°K, after which the star becomes bluer again and T_* increases; 3) at minimum

light no definite relation is observed between ϕ_1 and m_V, although the gradient is always lower than at neighboring bursts in brightness. The absolute energy distribution in the continuum of the star is derived; the ascending and descending branches of the flare are not equivalent. The effect of bright lines on the U, B, V magnitudes is estimated. These results indicate that the change in spectrum during a flare is of fundamental significance for an understanding of the SS Cyg flare phenomenon. (auth)

24899 STABILITY OF GRAVITATING SYSTEMS WITH A QUADRATIC POTENTIAL. II. SPHERICALLY AND AXIALLY SYMMETRIC MODEL CLUSTERS WITH ELLIPTICAL PARTICLE ORBITS. Polyachenko, V.L.; Shukhman, I.G. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation, Siberian Branch, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 4, 460-462 (Jan 1974).

The stability of a homogeneous spherically symmetric star cluster with arbitrary elliptical orbits is proved. A similar demonstration is given of the rotating, collisionless, gravitating cylinder against oscillations confined to the plane of rotation ($k_z=0$). (auth)

24900 THEORY OF THE THIRD INTEGRAL OF MOTION. Agekyan, T.A.; Yakimov, S.P. (Astronomical Observatory, Leningrad State University). Sov. Astron.–AJ 17: No. 4, 466-469 (Jan 1974).

It was shown in refs. 1 and 2 that in the case of an axisymmetric potential it is convenient to choose the third isolating intergral of motion K to be the ratio of the velocity components Z and Π in the center of the zero-velocity contour. A method is proposed for determining the velocity field in the meridian plane if the values of three isolating intergrals of motion are given. For this, on the $z=0$ axis, one first determines the functions $f_i(R, 0, 0)$ (for the value $K=0$) and one then uses these functions on the same axis to calculate the functions $f_i(R, 0, K)$, after which the functions $f_i(R, z, K)$ are determined in the complete region bounded by the corresponding box. A theorem is proved: In the meridian plane the derivative of the angle of the direction of motion with respect to the third intergal is proportional to the surface density. Equations are found for the box sides and their variation with varying K is determined. (auth)

24901 GALACTIC ROTATION OF DIFFERENT GROUPS OF OBJECTS. Karimova, D.K.; Pavlovskaya, E.D. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 17: No. 4, 470-475 (Jan 1974).

The rotation about the galactic center of different groups of objects belonging to both the flat and spherical components of our galaxy is investigated on the basis of available radial velocities. The differences at distance $R_\odot$ between the angular rotational velocities of given centroids and the centroid of stars in the solar neighborhood are estimated. Very different objects exhibit the same rotation law in the solar neighborhood, but their angular velocity varies widely, from 4 to 25 $km.sec^{-1}.kpc^{-1}$. An analytic expression is obtained for the angular velocity as a function of galactocentric distance. (auth)

24902 CARBON AND NITROGEN ABUNDANCES IN METAL-POOR STARS. Sneden, C. (McDonald Observatory and Department of Astronomy, University of Texas at Austin, Austin, Texas 78712). Astrophys. J. 189: No. 3, 493-507 (1 May 1974).

Carbon and nitrogen abundances have been derived for 10 metal-poor stars. For each star, a combination of coarse and fine analyses have been used to determine a model atmosphere. Then, using the model and atomic- and molecular-line parameters in a spectrum-synthesis program, artificial CH, CN, and NH spectra have been computed. Finally, by comparing the synthetic and observed spectra, carbon and nitrogen abundances have been obtained. The principal results of the analysis are: (1) in metal-poor dwarfs $[C/Fe] \simeq +0.0$; (2) all but one dwarf also show $[N/Fe] \simeq +0.0$; (3) metal-poor giants with $\log g \lesssim 2.4$ appear to possess $[C/N] \lesssim 1.0$, while those with higher gravities show $[C/N] \gtrsim +0.0$. The anomalously low [C/N] values are interpreted here as effects of internal evolutions of the giant metal-poor stars. Finally, the consequences for galactic nucleo-synthesis theories using the present results are discussed. (auth)

24903 FG SAGITTAE: THE s-PROCESS EPISODE. Langer, G.E.; Kraft, R.P.; Anderson, K.S. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz). Astrophys. J. 189: No. 3, 509-521 (1 May 1974).

The spectrum of the supergiant FG Sge has been studied from a series of high dispersion 120-inch (3-m) coudé spectrograms obtained during the interval 1969–1972, thus continuing the work of Herbig and Boyarchuk. The star, of effective temperature about 6500°K in 1972, is cooling at the rate of 250°K yr^{-1}; it is known to have ejected a still visible planetary nebula some 6000 years ago. Abnormally strong absorption lines of Y II, Zr II, Ce II, La II, and other s-process species began to appear in the spectrum of the central star some time after 1967 and have progressively strengthened. Present abundances per gram of these elements are about 25 times the solar value. There is little doubt that the atmosphere of the star has been enriched in these elements during the past seven years, but the rate of enrichment now appears to be slowing down. The present evolutionary state of FG Sge, referred to as the Herbig–Boyarchuk (HB) phase, is discussed qualitatively on the basis of two model scenarios: (1) the HB phase is a post-planetary ejection episode associated with a He shell flash experienced by all stars with masses near $1\ M_\odot$; (2) the HB phase is a transient post-helium-shell-flash phenomenon in a more massive red giant, immediately preceding its transformation into a Ba- or S-type star. Observational and theoretical difficulties with each of these scenarios are discussed. (auth)

24904 AN INTERPRETATION OF THE PUZZLING OBSERVATIONS OF FG SAGITTAE. Christy-Sackmann, I.; Despain, K.H. (California Institute of Technology, Pasadena, California 91109). Astrophys. J. 189: No. 3, 523-530 (1 May 1974).

The three major phenomena observed in FG Sgr—namely, (i) the existence of a planetary nebula, (ii) the large increase in apparent brightness with the extremely fast, continued increase in spectral type, and (iii) the observed increases in surface abundances with their respective time scales of ~6000 years, ~100 years, and ~1 year—can all be consistently explained in terms of helium-shell flashes, with the last flash taking place on the order of 10^2 years ago. A present mass on the order of $0.8\ M_\odot$ follows, with the initial main-sequence mass of the order of $3\text{–}5\ M_\odot$ when the 6000 years since the ejection of the planetary nebula is taken as an interflash period. It is suggested that a better agreement between theory and observations would be obtained if the distance of FG Sge were increased by 60 percent to 4 kpc, which would lead to an expansion time of 9600 years, a present mass for FG Sge on the order of $0.73\ M_\odot$, and an intrinsic luminosity of $M_{bol} \simeq -5.5$ mag. The presence and time scale of the increases in s-process element abundances suggest that a flash-driven intershell convective zone penetrated into the envelope and that some type of mixing existed in the outer envelope for a spectral type as early as F0. Strong lithium lines may show up in the next few years if a few conditions are met. The presence or absence of such lines would provide an important clue to the interior structure of FG Sge. No ^{13}C enhancement should be seen. (auth)

24905 NUCLEOSYNTHESIS OF LITHIUM IN LOW-ENERGY FLARES. Canal, R. (Departamento de Fisica de la Tierra y del Cosmos, Universidad de Barcelona, Spain). Astrophys. J. 189: No. 3, 531-533 (1 May 1974).

New values for the rates of Li formation in low-energy flares occurring on stellar surfaces are reported. Inclusion of the α-induced reactions significantly lowers the energetic requirements pointed out by previous authors. This fact, together with the recent determination of the interstellar Li abundance by Traub and Carleton ($Li/H \simeq 2\times10^{-10}$), suggests an autogenetical origin for the high Li abundances ($\sim10^{-7}$) found in young stars. (auth)

24906 DYNAMICAL PHASES OF ROTATING SUPERMASSIVE STARS. Fricke, K.J. (California Institute of Technology, Pasadena, California, and Universitätssternwarte Göttingen). Astrophys. J. 189: No. 3, 535-542 (1 May 1974).

The dynamical evolution of supermassive stars including angular momentum has been calculated using a simple approximation procedure. The results indicate that—regardless of the amount of angular momentum—explosions do not occur as long as metals are initially absent. For normal Population I composition, gigantic explosions are found involving masses from 4×10^5 to $2\times10^8\ M_\odot$, and explosion energies between 10^{56} and 10^{60} ergs which are also typical for the most violent local events observed in the Universe. (auth)

24907 THE EFFECTS OF RAPID, DIFFERENTIAL ROTATION ON THE SPECTRA OF WHITE DWARFS. Milton, R.L. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz). Astrophys. J. 189: No. 3, 543-554 (1 May 1974).

A grid of hydrogen-rich model atmospheres, including the effects of both line blanketing and convection has been calculated for a range of temperatures and gravities appropriate for DA white dwarfs. These atmospheres have been fitted to a series of interior models for differentially rotating white dwarfs of large mass ($1.58\ M_\odot \leq M \leq 4.06\ M_\odot$) to determine the observable spectra for such objects. Some of the spectra calculated are similar to the DC white dwarfs; some are similar to the spectra of DAwk white dwarfs; and others are indistinguishable from nonrotating DA white dwarfs. (auth)

24908 AN INVESTIGATION OF ACCRETION OF MATTER ONTO WHITE DWARFS AS A POSSIBLE X-RAY MECHANISM. DeGregoria, A.J. (Department of Astronomy, Columbia University). Astrophys. J. 189: No. 3, 555-561 (1 May 1974).

The accretion flow onto white dwarfs is investigated by numerically integrating the full nonlinear hydrodynamic equations under the assumption of spherical symmetry to determine the short-term time-dependent behavior, to determine the effects on the flow when

radial modes of oscillation of the star are excited, to see if X-rays are produced, and to determine the radiation spectrum. Some applications of the results to known X-ray sources are suggestive. (auth)

24909 AN EXCITATION MECHANISM FOR PULSATIONS IN BETA CEPHEI STARS. Osaki, Y. (Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder, Colorado 80302). Astrophys. J. 189: No. 3, 469-477 (1 May 1974).

A mechanism which might be responsible for the excitation of pulsations in β Cephei stars is proposed in which an eigenmode of the nonradial oscillations of the whole star resonates with the overstable convection in the rapidly spinning core of a massive star. The degeneracy of the two frequencies is found to be possible only in the late stages of core hydrogen burning in massive stars. The equations for adiabatic, nonradial oscillations have been solved for a realistic stellar model, and it is shown that the eigenfunction of the f-mode has large amplitudes only in the convective core and near the surface, which is a situation favorable to the operation of this mechanism. The resonant excitation of a nonradial oscillation by oscillatory convection has been formulated on the basis of Lighthill's method. The coupling occurs linearly in the presence of rotation, and a crude estimate is given for the amplitude of the excited oscillation. The most likely mode excited by this mechanism is a sectoral mode, which is a wave traveling around the equator in the same direction as the rotation; and this seems to agree with observations. (auth)

24910 PROFILES OF EMISSION LINES IN Be STARS. III. FURTHER STUDY OF THE LONG-PERIOD V/R VARIATION. Albert, E.; Huang, S. (Department of Astronomy, Northwestern University). Astrophys. J. 189: No. 3, 479-483 (1 May 1974).

The long-period V/R emission variations in three Be stars, HD 20336, 25 Ori, and β^1 Mon have been studied according to the mathematical formulation of the eccentric rotating model presented in a previous paper. The predictions of the theory fit satisfactorily the general trend of observed data. Periods, eccentricities, and sizes of the emitting ring with respect to the stellar radius are thereby derived and found to be consistent with results of the previous investigation of 105 Tauri. (auth)

24911 INTERPRETATION OF EPSILON AURIGAE. III. STUDY OF THE LIGHT CURVE BASED ON DISK MODELS. Huang, S. (Department of Astronomy, Northwestern University). Astrophys. J. 189: No. 3, 485-491 (1 May 1974).

The light curve expected from the eclipse of a star by a companion possessing a semitransparent disk has been investigated. Two computational procedures for deriving the light curve based on the geometrically thin-disk model are given here. Using these procedures, we have calculated the light curves of ϵ Aur based on different sets of parameters including those given previously by Wilson. We have also studied the light curve of ϵ Aur based on a geometrically thick disk model, and have advanced two proposals in order to understand the change in the shape of the light curve from one eclipse to the next, namely, (1) the rapid evolution that occurs in the disk and (2) the density waves in the disk and/or individual condensations that are revolving around the secondary each in an independent way. Whether the disk is thin or thick, we have shown that the observed light curve and the opacity distribution in the disk are related by an integral equation. Consequently, once the thickness is given, the fitting of the light curve is basically a question of assigning the opacity distribution to the disk, and vice versa. (auth)

24912 SPECTRAL CLASSIFICATION FROM INFRARED SPECTRA OF MODERATE DISPERSION. Albers, H. (Vassar College Observatory, Poughkeepsie, New York). Astrophys. J. 189: No. 3, 463-467 (1 May 1974).

The various kinds of spectra that can be recognized on widened infrared objective-prism spectra having a dispersion of 700 Å mm^{-1} are discussed. A temperature sequence is shown for the giant M stars as well as the luminosity effects which can be used to identify dwarf and supergiant M stars. The criteria which can be used to select high-luminosity stars in other parts of the spectral sequence are described. Other groups of stars which can be identified from these spectra are illustrated. (auth)

24913 INTERMEDIATE-BAND PHOTOMETRY OF M67. Janes, K.A. (Yale University Observatory, New Haven, Connecticut). Astrophys. J. 189: No. 3, 423-426 (1 May 1974).

Observations on the DDO photometric system have been obtained of 24 stars on the giant and subgiant branches of the old cluster, M67. Recent calibrations of DDO photometry make possible estimates of reddening, distance modulus, and a gravity-independent index of cyanogen strength all for a single G or K giant star. Using these procedures, the following values are obtained: $E(B-V) = 0.051 \pm 0.004$ mag, $(m-M) = 9.26 \pm 0.09$ mag, and $\delta CN = 0.032 \pm 0.005$ mag. The index δCN is a measure of the metallicity of a star, and the value obtained here is midway between typical G and K giants (for which δCN is defined to be zero) and the Hyades giants ($\delta CN = 0.063$). Thus the results of Eggen and Sandage are confirmed and M67 has a normal composition. Furthermore, there is no evidence that the "clump" stars are mixed or have lost mass. (auth)

24914 THE OLD OPEN CLUSTER NGC 2420. McClure, R.D.; Forrester, W.T.; Gibson, J. (Yale University Observatory). Astrophys. J. 189: No. 3, 409-421 (1 May 1974).

New photographic and photoelectric photometry on the UBV system is presented for stars in the old open cluster NGC 2420. This photometry confirms the ultraviolet excess of δ (U-B) = 0.09 mag and almost negligible reddening reported by West. Intermediate band photometry on the DDO system indicates that the giants in the cluster have weak cyanogen bands ($\delta CN = -0.06$). Both types of photometry imply a low heavy element abundance for the cluster of $[Fe/H]_{Hyd} = -0.5$. A distance modulus of $(m-M)_0 = 11.4 \pm 0.2$ mag and an age of $3.3 \pm 0.5 \times 10^9$ years (assuming a helium abundance $Y = 0.3$) are derived. The radial velocity of the cluster from measurements of three giant stars is $> +100$ km s^{-1}. The cluster is interesting in that it is about 650 pc from the galactic plane, metal poor, and a high-velocity object, and yet has a relatively young age. An extreme barium II star was found in the cluster. Its derived absolute magnitude is $M_v = 0.0$ mag. (auth)

24915 CYANOGEN-BAND STRENGTHS OF GIANT STARS IN 47 TUCANAE. McClure, R.D. (Yale University Observatory); Osborn, W. Astrophys. J. 189: No. 3, 405-407 (1 May 1974).

Photoelectric photometry on the DDO system has been obtained for stars on the giant branch of the globular cluster 47 Tucanae in order to obtain a quantitative measure of the cyanogen-band strength. A value of metal abundance inferred from the CN strengths is in very good agreement with that inferred from the ultraviolet excesses, This value is approximately 1/4-1/5 Hyades abundance. (auth)

24916 TIME VARIATIONS IN THE OH MICROWAVE AND INFRARED EMISSION FROM LATE-TYPE STARS. Harvey, P.M. (George W. Downs Laboratory of Physics, California Institute of Technology, Pasadena, California); Bechis, K.P.; Wilson, W.J.; Ball, J.A. Astrophys. J. Suppl. Ser. 27: No. 248, 331-358 (Apr 1974).

The OH microwave and infrared variability of 14 OH/IR stars were studied. Many of the sources show periodic flux variation between 1 and 10 μ and in 1612-MHz OH lines with no appreciable phase difference between the infrared and microwave. The best explanation for this correlation seem to that the OH masers are radiatively pumped. In at least two sources the 1665- and 1667-MHz variations are significantly greater and more random than in the 1612- MHz sources. These data are not of sufficient quality to determine if the 1665/1667-MHz and infrared variations are significantly correlated. A correlation does exist between the period of variation, the amplitude of variation at 2.2 μ, the [3.5μ]-[10μ] color index, the separation in velocity of the two OH emission features, and the existence of 1.35-cm H_2O emission in the Mira type stars observed. No evidence is seen in the infrared for periodic variations of the color temperatures of the circumstellar shells which are believed to surround many of these stars. (auth)

24917 THE ULTRAVIOLET SPECTRUM OF ETA CANIS MAJORIS, B5 Ia. Underhill, A.B. (NASA, Goddard Space Flight Center, Greenbelt, Maryland 20771). Astrophys. J. Suppl. Ser. 27: No. 249, 359-390 (May 1974).

A list of lines visible in OAO-3 spectrum scans of the spectrum of η CMa, B5 Ia, is presented for the regions 1008-1425 Å and 1890-3105 Å. The spectra definitely present in the ultraviolet are H I, He I, C II, C III, N I, N II, O I, O II, Mg I, Mg II, Al II, Al III, Si II, Si III, Si IV, S II, S III, S IV, Ti III, V III, Cr II, Cr III, Mn III, Fe II, Fe III, Ni II. The following spectra are probably present: B II, Si I, P II, P III, Cl I, Cl III, Ca II, Sc III, Ti IV, Cr IV, Mn IV, Ni III, and Y III. The broad resonance lines of C II, N II, Mg II and Si IV are shortward displaced on the average by 120 km s^{-1}. The C III blend at 1176 Å is undisplaced. Strong undisplaced zero-volt lines of Mg I and Mg II arise from a stationary circumstellar envelope which is shown also by the resonance lines of Ca II and Na I. The zero-volt lines of Fe II may also be formed in this circumstellar shell. Line-blocking factors for each 10 Å of spectrum from 1010 to 1420 Å are given to table 3; blocking factors for each 20 Å of spectrum between 1900 and 3080 Å are given in table 4. (auth)

24918 HOOK-METHOD MEASUREMENTS OF GF-VALUES FOR ULTRAVIOLET FEI AND Fe II LINES ON A SHOCK TUBE. Huber, M.C.E. (Center for Astrophysics, Harvard College Observatory). Astrophys. J. 190: No. 1, 237-240 (15 May 1974).

Transition probabilities for 14 lines of Fe ii and 12 lines of Fe i in the wavelentgh region 2560-2737 Å were measured by use of a shock tube and the hook method. Absolute oscillator strengths for resonance lines of Fe i reported by Banfield and Huber were used to determine the number density of neutral iron in the shock-heated gas. With the assumption of thermal equilibrium, the density of singly ionized iron

atoms in this gas was then computed from the measured temperature and pressure with the aid of the Saha equation. Our results on the 12 strongest of the 13 lines belonging to the first ultraviolet multiplet of Fe II indicate that the multiplet f-value is larger by a factor of 2 than that derived from lifetime measurements by Assousa and Smith. (auth)

24919 THE EFFECTS OF THE 35-DAY X-RAY CYCLE ON THE LIGHT CURVE OF HZ HERCULIS. Grandi, S.A.; Hintzen, P.M.N.O.; Jensen, E.B.; Rydgren, A.E.; Scott, J.S.; Stickney, P.M.; Whelan, J.A.J.; Worden, S.P. (Steward Observatory, University of Arizona). Astrophys. J. 190: No. 2, 365-373 (1 June 1974).

We report extensive photoelectric UBV photometry of the variable star HZ Her, originally undertaken to discover possible correlations between variations in its 1.7-day light curve and the 35-day cycle of the X-ray source Her X-1. Correlations recently reported by other groups are confirmed. These, as well as other features observed, are provisionally analyzed using a model consisting of a primary star filling its Roche lobe and being illuminated by X-rays. The X-rays are emitted in a beam fixed in a rotating, precessing, neutron-star secondary. Additional light is being contributed by material being transferred from the primary to the secondary. (auth)

24920 NUMERICAL MODELS FOR SUPERNOVA REMNANTS. Mansfield, V.N.; Salpeter, E.E. (Center for Radiophysics and Space Research, Cornell University, Ithaca, New York). Astrophys. J. 190: No. 2, 305-313 (1 June 1974).

Numerical calculations are presented for supernova ejecta with initially constant total energy E_0 expanding into interstellar medium of uniform density n_0, assuming perfect spherical symmetry. Scaling laws are presented for changes in E_0/n_0 with constant $E_0n_0^2$. Results are given for the time development of various quantities, including the emitted X-ray spectrum, for three different values of $E_0n_0^2$. (auth)

24921 He I λ4471 PROFILES IN B STARS: CALCULATIONS WITH AN IMPROVED LINE-BROADENING THEORY. Mihalas, D. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado); Bernard, A.J.; Cooper, J.; Smith, E.W. Astrophys. J. 190: No. 2, 315-318 (1 June 1974).

Theoretical profiles for the He I λ4471 line in B-star spectra have been computed using an improved broadening theory of Barnard, Cooper, and Smith, together with level populations determined by a self-consistent solution by Auer and Mihalas of the coupled transfer and statistical-equilibrium equations. The broadening theory has been constructed to provide a more accurate description of the intensity and width of the forbidden ($2p^3P^0$–$4f^3F^0$) transition as measured in laboratory experiments. The results presented in this paper show that this revision of the broadening theory leads to computed stellar profiles which are in much better agreement with observed profiles than any previously obtained. (auth)

24922 THE NATURE OF INFRARED EXCESSES IN EXTREME Be STARS. Schild, R.; Chaffee, F.; Frogel, J.A.; Persson, S.E. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. 190: No. 1, 73-83 (15 May 1974).

Newly measured energy distributions from 0.32–3.5 μ for all the extreme Be stars around $_{\chi}$ Per show an infrared excess beginning at 0.5 μ, peaking shortward of 1 μ, and declining at longer wavelengths. This excess is not likely to be thermal radiation from dust, but appears to be continuum radiation from the free-bound electron interaction with neutral hydrogen. The emission presumably originates in a large gas shell around the extreme Be stars. The H-R diagrams for four clusters containing extreme Be stars are consistent with the hypothesis that the extreme Be stars are in the core-contraction stage of post-main-sequence evolution, following exhaustion of hydrogen in their convective cores. The possible role of resonance absorption in providing pressure support for the very large extreme Be star shells is noted. The eight extreme Be stars observed to date are found to have continuous or nearly continuous energy distributions across the Balmer jump. None appears to have a Balmer discontinuity in emission. One star varied by 0.3 mag at 1.6 and 2.2 μ, and a second appears to have varied by 0.1 mag, on a time scale of 1 year. (auth)

24923 MEAN ABSOLUTE MAGNITUDES OF CARBON STARS AND RELATED OBJECTS. Baumert, J.H. (Perkins Observatory, Ohio State and Ohio Wesleyan Universities). Astrophys. J. 190: No. 1, 85-90 (15 May 1974).

Statistical methods which use proper motions and radial velocities have been employed in conjunction with narrow-band photometry to determine the mean absolute magnitudes of carbon stars and related objects at 1.04 μ. The N-type stars have $\langle M(104)\rangle = -4.3$ and are 2.6 mag brighter than the R-type stars. When the variable stars are removed from these groups the nonvariable R and N stars both have $\langle M(104)\rangle = -1.2$. Among the variable stars the brightness increases in the sequence Lb–SRb–Mira –SRa; within each variability type, however, the absolute magnitudes show no clear dependence upon the CN strength or temperature. The barium stars have absolute magnitudes similar to the G and K giants with the value −1.1. (auth)

24924 THE DOPPLER SPLITTING OF SPECTRAL LINES IN PULSATING STARS. Skalafuris, A.J. (Bartol Research Foundation, Swarthmore, Pennsylvania). Astrophys. J. 190: No. 1, 91-93 (15 May 1974).

Uniformly accelerated hydrodynamic flow, with radiation pressure and dissipation, is considered. It is shown that during Cepheid contractions only shock waves above a minimum strength can be generated by the star's dynamic gravity; hence strong lines are first to show the velocity discontinuity. Population I stars have small radial variations and cannot reach this minimum shock strength, hence can at most reveal only an initial set of spectral lines. (auth)

24925 s-PROCESS NUCLEOSYNTHESIS IN MASSIVE STARS: CORE HELIUM BURNING. Couch, R.G.; Schmiedekamp, A.B. (Center for Nuclear Studies, University of Texas at Austin); Arnett, W.D. Astrophys. J. 190: No. 1, 95-100 (15 May 1974).

We have investigated the nucleosynthesis which takes place via neutron capture during core helium burning in massive stars ($M \gtrsim 15M_\odot$). The neutrons are produced by the $^{22}Ne(\alpha,n)^{25}Mg$ reaction. It was found that complete conversion of ^{22}Ne to ^{25}Mg can take place only in the most massive stars ($M \gtrsim 30M_\odot$). Little buildup of elements heavier than A = 90 can occur; this is due to the competition of lighter neutron poisons, particularly from the ^{25}Mg produced by the neutron source reaction. Although the shape of the abundance distribution of s-process nuclei in the range $60 \lesssim A \lesssim 90$ is fairly well reproduced, total production of these nuclei appears to be inadequate by a factor of 3 to 8. The abundances of many rare light nuclei such as ^{36}S, ^{40}Ar, ^{40}K, ^{43}Ca, ^{45}Sc, and ^{58}Fe are considerably enhanced. It also appears possible that insignificant production of the more abundant nuclei ^{22}Ne, ^{25}Mg, and ^{26}Mg may occur in these burning regions. This study indicates that it is particularly important to obtain experimental data on the neutron-capture cross-sections of ^{22}Ne, ^{25}Mg, and ^{58}Fe. (auth)

24926 HORIZONTAL-BRANCH EVOLUTION WITH SEMICONVECTION. I. INTERIOR EVOLUTION. Sweigart, A.V. (Yale University Observatory, New Haven, Connecticut); Gross, P.G. Astrophys. J. 190: No. 1, 101-107 (15 May 1974).

The evolution of a 0.66 $M_\odot$ star has been followed through the horizontal-branch phase with a full treatment of both convective overshooting and semiconvection. During most of the evolution this star possesses a semiconvective zone that at its maximum extent contains 0.11 $M_\odot$. The horizontal-branch lifetime is shown to be uncertain by as much as 15 to 20 percent because of the uncertainty in the reduced alpha-particle width for the $^{12}C(\alpha,\gamma)^{16}O$ reaction. The dependence of the interior structure on the degree of superadiabaticity within the semiconvective zone is determined. One model sequence, constructed with an estimate for the time scale of convective overshooting, indicates that any superadiabaticity in the semiconvective zone will probably be small. A discussion of the input physics and numerical procedure is included. (auth)

24927 ARE THE UV STARS NUCLEAR-POWERED? Hills, J.G. (Department of Astronomy, University of Michigan, Ann Arbor, Michigan 48104). Astrophys. J. 190: No. 1, 109-115 (15 May 1974).

The UV stars (hot pre-white dwarfs) may be fueled by nuclear energy rather than merely by gravitational contraction as has usually been assumed. Evolutionary models of white dwarfs without nuclear burning are used to determine their contribution to the observed far-ultraviolet excess in galaxies and their frequency in stellar systems. It is found that white dwarfs with an average mass of 0.7 $M_\odot$ are able to produce the ultraviolet excess observed in the nucleus of M31 only if they do not emit neutrinos as directed by the theory of universal Fermi interactions. It is further found that the observed number of UV stars in this cluster are almost certainly evolving on a nuclear time scale. These UV stars may be powered by the conversion of their residual helium to carbon near the helium-burning main sequence for pure helium stars. There is enough of this fuel to permit the UV stars to emit up to 10 percent of the total radiation from a stellar system. This is adequate to explain both the far-ultraviolet flux in galaxies and the number of UV stars in M3. UV stars more massive than about 0.8 $M_\odot$ may even be able to burn their carbon to magnesium, and this process could release an additional quantity of energy about equal to that released by helium burning. The theory that the UV stars are responsible for the ionization of the intercloud medium (ICM) is in better agreement with observations if the UV stars are nuclear-powered rather than powered only by gravitational contraction. Because of their lower average surface temperatures the nuclear-powered UV stars would produce a much less highly ionized ICM than that produced exclusively by the much hotter white dwarfs powered only by gravitational contraction. A less highly ionized ICM is supported by recent observations by the Copernicus satellite. The longer average lifetime of the nuclear-powered stars increases the theoretical space density of the UV stars, which is also in better agreement with observations. (auth)

24928 OBSERVATIONS FOR BROAD-BAND CIRCULAR POLARIZATION IN WHITE DWARFS AND NUCLEI OF PLANETARY NEBULAE. Rich, A.; Williams, W.L. (Department of

Physics, University of Michigan, Ann Arbor). Astrophys. J. 190: No. 1, 117-120 (15 May 1974).

Observations have been made to search for broad-band optical circular polarization in the radiation from eight white dwarfs, four planetary nuclei, and the peculiar blue variable CoD-42°14462. All results are negative with the exception of a possible effect in the central star of He 2-131. (auth)

24929 THE FISSION THEORY OF BINARY STARS, II. STABILITY TO THIRD-HARMONICS DISTURBANCES. Lebovitz, N.R. (University of Chicago). Astrophys. J. 190: No. 1, 121-130 (15 May 1974).

The stability of the compressible Riemann ellipsoids to modes of disturbance associated with the third ellipsoidal harmonics is worked out, and the implications of the stability theory for the evolution of a contracting, ellipsoidal mass are discussed. The principal qualitative difference from the classical, incompressible theory is the occurrence of extremely narrow bands of instability in the plane of the parameters. The presence of these bands makes the evolution of an ellipsoidal mass very sensitive to the initial state of the ellipsoid. All contracting, ellipsoidal masses of large enough angular momentum and small enough initial departure from axial symmetry become unstable, at some stage in their evolution, to third-harmonics disturbances. However, a certain fraction of contracting masses, which have initial departures from axial symmetry above a certain critical value, may escape the third-harmonics instability and become unstable first to harmonics of fourth or higher order. (auth)

24930 ROTATING SUPERFLUID IN NEUTRON STARS. Ruderman, M.A.; Sutherland, P.G. (Department of Physics, Columbia University, New York, New York 10027). Astrophys. J. 190: No. 1, 137-139 (15 May 1974).

A rotating perfect fluid subject to axisymmetric, azimuthal, time-independent forces is shown to have a uniform angular acceleration on each coaxial cylindrical surface. In a rotating superfluid, uniform rotation is mimicked by a dense corotating paraxial array of quantized vortices. The above classical result is approached when external forces on the vortices vary on a scale large compared with the intervortex spacing. In such cases, despite forces which vary greatly along individual vortex lines, the vortices move radially but remain parallel to the rotation axis. This resistance to bending suppresses the development of superfluid turbulence in interiors of rapidly rotating neutron stars. (auth)

24931 PHOTON OPACITY IN SURFACES OF MAGNETIC NEUTRON STARS. Lodenquai, J.; Canuto, V. (Institute for Space Studies, New York, New York 10025); Ruderman, M.; Tsuruta, S. Astrophys. J. 190: No. 1, 141-152 (15 May 1974).

Approximate expressions are derived for free-free, bound-free, and Thomson cross-sections of photons by gaseous matter in the presence of superstrong magnetic fields. For photons in modes whose electric field polarization is perpendicular to this magnetic field, the cross-section is reduced by approximately the squared ratio of the photon frequency to the electron cyclotron frequency if this ratio is small. (auth)

24932 NUMERICAL MODELS OF THE EVOLUTION OF SUPERNOVA REMNANTS: THE SHELL-FORMATION STAGE. Straka, W.C. (Department of Astronomy, Boston University, Boston, Massachusetts 02215). Astrophys. J. 190: No. 1, 59-66 (15 May 1974).

Numerical calculations of the behavior of supernova remnants have been carried out at several initial energies, with emphasis on the thermally unstable shell-formation phase. An approximate formula to fit the Cox cooling curves has been used. Thermal bremmstrahlung has been included exactly. The recombination region is fitted well, although Lα, the 1s-2p(O), and the 2s-2p (O, Si, S) transitions are underrepresented. The effect of this deviation is discussed. It is found that the time of onset of rapid shell formation is related to the time at which the temperature just behind the shock front in the Sedov phase decreases to the point that recombination processes exceed thermal bremsstrahlung ($\sim 2\times 10^6$ K). The time of onset of shell formation is only weakly dependent on the cooling coefficient, although the rate of formation is faster for a higher coefficient. For the best approximation to the Cox curves, the maximum density reached in the shell is higher for higher initial energy. In all cases, the resultant thin, dense, cool shell behaves like a momentum-limited piston which collides inelastically with the medium. This is in agreement with earlier calculations in this series and with earlier estimates made in general discussions by other authors. (auth)

24933 LATE STAGES OF STELLAR EVOLUTION IN THE LIGHT OF ELLIPTICAL GALAXIES. Rose, W.K.; Tinsley, B.M. (Astronomy Program and Center for Theoretical Physics, University of Maryland). Astrophys. J. 190: No. 2, 243-251 (1 June 1974).

The predicted spectral energy distributions, broad-band colors, and spectral features of the integrated light of giant elliptical galaxies are studied using a variety of assumptions concerning evolution of solar-mass stars after core helium ignition. Uncertainties in the duration of core burning have little effect at wavelengths longer than 1 μ. Uncertainties in the final stellar core mass at the end of red-giant evolution, which determines the bolometric energy output per star, affect the light at wavelengths >0.8 μ. Final core masses greater than 0.7$M_\odot$ appear to be ruled out by the excess of red light that would be emitted by late giants, independently of other uncertain parameters entering the theoretical spectral energy distributions (age, initial mass function, etc.). Interestingly, this is just the core mass at which stellar models predict that instabilities should cause loss of the envelope and rapid contraction from a red giant to a hot "ultraviolet star." The contribution to galactic light from these ultraviolet stars is estimated to be important only at wavelengths $\lesssim$ 2000 Å, depending on the ultraviolet star mass (i.e., the final red-giant core mass) and on whether or not neutrino losses occur. It is predicted that the ultraviolet stars are numerous enough to photoionize the gas ejected from red giants, at least until this gas has fallen to the galactic nucleus. (auth)

24934 ULTRAVIOLET PHOTOMETRY FROM THE ORBITING ASTRONOMICAL OBSERVATORY. XV. THE STRONGLY MAGNETIC VARIABLE HD 215441. Leckrone, D.S. (National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. 190: No. 2, 319-326 (1 June 1974).

The Wisconsin Experiment Package on OAO-2 was used to obtain light curves of the strongly magnetic, variable Ap star HD 215441 over the wavelength range 1550-4250 Å. This star is characterized by a lack of outstanding spectrum variability at wavelengths accessible from the ground, while undergoing UBV photometric variations of large amplitude. The vacuum ultraviolet data show that the UBV variations are driven by a time-variable redistribution of flux from the ultraviolet to the visible (variable backwarming), similar to the mechanism previously noted by Molnar in the well-known spectrum variables α^2 CVn and ε UMa. At 2980 Å HD 215441 varies in phase with the visible; the data firmly establish 2460 Å as a "null wavelength" at which the star does not vary systematically in brightness with phase; shortward of 2460 Å the star reaches minimum brightness at the time of visible maximum. The effective temperature of HD 215441, crudely estimated as ~14,500°K, does not vary by more than a few hundred degrees over the star's cycle and may well be constant as a function of phase. The observations of HD 215441 demonstrate that an Ap star need not be a striking spectrum variable at blue-visible wavelengths for its photometric variations to be controlled by opacity variations in the ultraviolet. (auth)

24935 THE EXTRAORDINARILY SLOW MAGNETIC VARIATION OF GAMMA EQUULEI. Bonsack, W.K.; Pilachowski, C.A. (Institute for Astronomy, University of Hawaii). Astrophys. J. 190: No. 2, 327-330 (1 June 1974).

Sixty-one observations of the Zeeman effect in the spectrum of γ Equ are reported, covering the years 1963 to 1973. These are discussed together with Babcock's results for 1946-56. The magnetic field has apparently been declining monotonically from a broad and ill-defined maximum of +500 gauss near 1952 to a value of -150 gauss in 1973. If the star's magnetic cycle is symmetrical about a zero field, the period may be as long as 72 years. No evidence for short-period fluctuations about the mean curve exists in the newer data. (auth)

24936 ON THE INCLINATION OF ROTATION AXES IN VISUAL BINARIES. Weis, E.W. (University of Illinois Observatory). Astrophys. J. 190: No. 2, 331-337 (1 June 1974).

Spectral types and projected rotational velocities are determined for a number of visual binary systems with known orbits. These data, along with data for other visual binaries taken from the literature, are used to demonstrate a tendency for the rotation axes to be aligned perpendicular to the orbital planes in such systems. This tendency appears strong in F stars while the evidence for A stars is rather weak. The question of coplanarity of orbits in triple systems is briefly discussed. (auth)

24937 INFRARED STARS IN BINARY SYSTEMS. Humphreys, R.M.; Ney, E.P. (University of Minnesota, Minneapolis). Astrophys. J. 190: No. 2, 339-347 (1 June 1974).

The peculiar A- and F-type supergiants, HD 101584, 89 Her, ν Sgr, and R CrB have large and unusual infrared excesses which may be due to the presence of a very cool companion. In HD 101584 (F2e Iap) more energy is radiated in the infrared than by the visible star. We suggest that the infrared energy is produced by an M supergiant companion instead of thermal reradiation by dust. HD 101584 also has a variable radial velocity with an amplitude of 20 km s^{-1}. A P Cygni profile is observed at Hδ and during two years the Ca II H- and K-lines had more negative velocities by 30 km s^{-1} from other lines. The stars 89 Her (F2e Ia) and ν Sgr (cApe) show infrared excesses similar to HD 101584 which may also be produced by a very cool star. The peculiar carbon-rich star R CrB (F8pep) has an infrared excess closely resembling the Cygnid-type infrared objects. R CrB also has a regular light curve at 3.5 μ like the long-period variables. The infrared companion may be responsible in someway for this star's erratic behavior in the visual region. (auth)

24938 COMPLEX INFRARED EMISSION FEATURES IN THE SPECTRUM OF BETA LYRAE. Morgan, T.H.; Potter, A.E.; Kondo, Y. (NASA Lyndon B. Johnson Space Center, Houston, Texas). Astrophys. J. 190: No. 2, 349-352 (1 June 1974).

Spectra of β Lyrae over the spectral region 5800–11,000 cm^{-1} (1.76–0.9 μ) at two different phases have been obtained. They show a remarkable emission–absorption complex at 9231 cm^{-1}, a highly structured emission at Pβ, and several additional broad weak emissions. (auth)

24939 FINITE NUCLEAR SIZE EFFECTS ON NEUTRINO–PAIR BREMSSTRAHLUNG IN NEUTRON STARS. Flowers, E. (Department of Physics, University of Illinois, Urbana, Illinois 61801). Astrophys. J. 190: No. 2, 381-383 (1 June 1974).

We consider the effects on neutrino–pair bremsstrahlung emission by electrons of the finite size of the charge distributions scattering the electrons. In general the finite size of the scattering center tends to reduce the importance of processes in which there is a large momentum transfer to the electron. The neutrino bremsstrahlung emission from electrons scattering from a static lattice including finite size effects is evaluated. At high density where the nuclei forming the lattice are rather large the finite size effects reduce the neutrino emission rates. Two different descriptions of the nuclei present in neutron-star matter are considered. In neutron stars at densities near 10^{14} g cm^{-3} the reduction in the energy radiated in neutrinos per second per unit volume can be almost a factor of 100 or as small as a factor of 2, depending upon the properties of the nuclei. (auth)

24940 CORRELATION EFFECTS ON THE ENERGY SHIFTS OF EXCITED NUCLEONS IN NEUTRON-STAR MATTER. Nandy, A. (Physics Department, Syracuse University, Syracuse, New York 13210). Astrophys. J. 190: No. 2, 385-390 (1 June 1974).

In a recent paper, Sawyer has calculated the shifts in the masses of the Δ^- particles in the presence of superdense matter and has shown that these shifts are large enough to preclude their appearance at densities of the neutron stars. In the present paper, the effects of correlations among the hadrons due to the presence of a universal repulsive core are considered and an upper limit found to the change in mass shifts obtained by Sawyer. This is seen to be rather large, and indicates that correlation effects have to be included in calculations of this type. The significance of these effects on the equation of state is also discussed. (auth)

24941 ON THE ELECTRODYNAMIC EQUILIBRIUM OF A SPACE CHARGE REGION AROUND A ROTATING NEUTRON STAR WITH AN ALIGNED MAGNETIC FIELD. Pilipp, W.G. (Max–Planck–Institut für Physik und Astrophysik, Institut für extraterrestrische Physik, 8046 Garching bei München, Germany). Astrophys. J. 190: No. 2, 391-401 (1 June 1974).

The problem of the electrodynamic equilibrium around a rigidly rotating, perfectly conducting neutron star with an azimuthally symmetric magnetic field aligned with the rotation axis is considered. In contrast to the usual assumption that the electric field parallel to the magnetic field vanishes everywhere in space around the neutron star because of the presence of space charge, it is also conceivable that the space charge region is confined to a finite volume of space around the neutron star and that there is vacuum outside of it. Then, in the vacuum, there could exist an electric field parallel to the magnetic field even in a stationary state. Starting with the assumption that a space charge cloud including the neutron star can adjust to such a shape confined to a finite volume that it is in electrodynamic equilibrium, it is shown that the magnetic field as well as the electric field outside the space charge region will vanish identically. Thus, there is an electrodynamic equilibrium everywhere in space. Furthermore, it is shown that either there is no magnetic field at all outside the neutron star or the space charge region must extend at least to the boundary of the light cylinder. (auth)

24942 ON THE STABILITY OF AXISYMMETRIC SYSTEMS TO AXISYMMETRIC PERTURBATIONS IN GENERAL RELATIVITY. V. DIFFERENTIALLY ROTATING CONFIGURATIONS. Will, C.M. (University of Chicago). Astrophys. J. 190: No. 2, 403-410 (1 June 1974).

We extend the theory developed in Papers I and II to allow for the effects of differential rotation. We derive a variational expression for the frequency of axisymmetric oscillations of relativistic differentially rotating configurations, and apply this formula to the quasi-radial modes of oscillation of slowly, differentially rotating stellar models. By appropriate redefinitions of variables, the theory is also applied to stationary nonaxisymmetric deformations of differentially rotating configurations. (auth)

24943 THE SPACE-TIME OF AXISYMMETRIC GRAVITATING MASSES. Fu, K.Y. (Department of Physics, National Taiwan University, Taipei, Taiwan). Astrophys. J. 190: No. 2, 411-415 (1 June 1974).

Axisymmetric space–time associated with astrophysical bodies of axial symmetry, which probably results from the presence of a strong magnetic field, is discussed. The static solution shows not Schwarzschild singularity which exists for the case of spherical symmetry. The nonstationary solution (applicable to the late stage of gravitational collapse), though it shows different behaviors to a comoving observer, as compared with the case of spherical symmetry, indicates that initial anisotropic stresses (which cause the axial symmetry) cannot prevent the body from eventual collapse "three dimensionally." The limiting character of the space–time for the dustlike matter has been investigated in detail. (auth)

24944 PRELIMINARY STUDY OF DO AQUARII. Todoran, I. (Astronomical Observatory, Cluj). Stud. Cercet. Astron.; 19: No. 1, 25-30(1974).

From the 468 photographic observations two light curves are drawn and the new photometric elements are based on 24 observed maxima. (auth)

24945 SPHERE–ELLIPSOID MODEL. Application for the Close Binary System XZ Andromedae. Urechе, V. (Univ., Cluj); Minti, H. Stud. Cercet. Astron.; 19: No. 1, 67-77(1974). (In Rumanian).

Using the result obtained by one of the authors (V. U.) for the ellipsoid–ellipsoid model, a new variant for the sphere–ellipsoid is proposed. The explicit formulae for the computation of the theoretical light curve of the primary minimum are given. The elements of the close binary system are determined by successive approximation, using the method of differential corrections. The partial derivatives are computed numerically. The observed light curve of the eclipsing binary star is used, avoiding the rectification procedures. The computation algorithm, proposed above, was transcribed in the FORTRAN IV language for an IBM 360 computer. The method was applied for the close binary system XZ Andromedae, using the photoelectric observations in blue of Reinhardt. For the elements of the system, new values were obtained. A computed light curve in better agreement with observations of the primary minimum was obtained. The secondary component seems to be an undersized subgiant. (auth)

24946 DETERMINATION OF AGE FOR SOME OPEN CLUSTERS. Dinescu, R. (Astronomical Observatory, Bucharest); Muzylev, V. Stud. Cercet. Astron.; 19: No. 1, 79-87(1974). (In Rumanian).

The paper presents estimations of the age for ten open clusters, by comparison of the star positions in the H–R diagram with the theoretical isochrones constructed on the basis of the evolution tracks for 1.5 $M_\odot$ to 15 $M_\odot$. For the construction of isochrones a method elaborated at the Astronomical Council from Moscow was used. The results are presented and a comparison with other authors is given. (auth)

24947 ECLIPSING BINARY RT ANDROMEDAE. II. Dumitrescu, A. (Astronomical Observatory, Bucharest). Stud. Cercet. Astron.; 19: No. 1, 89-97(1974). (In Rumanian).

New elements are given for the eclipsing binary RT And. (WDM)

24948 PHOTOPOLARIMETRY OF PLANETS AND STARS. Gehrels, T. (Univ. of Arizona, Tucson). Vistas Astron.; 15: 113-129(1973).

This is a review, completed by April 1971, of the wide range in polarization-wavelength dependence that is found in astronomy. Polarimetry allows the determination of a dusty surface texture for objects without an atmosphere, of the optical thickness and aerosol characteristics for thick atmospheres, and of particle parameters for interstellar grains. The observed phenomena of Quasar 3C345 and of Pulsar NP 0532 are similar, except for time-scale, which appears to support Morrison's (1969) suggestion that these are similar objects, except in size. (IAA) (auth)

24949 THE STRUCTURE OF LATE TYPE STARS AND THE HAYASHI TRACK. Caputo, F.; Castellani, V.; D'Antona, F. A. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Astrophys. Space Sci.; 28: No. 2, 303-324(Jun 1974).

A topological approach in the HR diagram is given for the occurrence and the characteristics of convective envelopes in population II stars. The location of the Hayashi track and of the Red Giants branch are both investigated for various assumed masses of the stars and chemical compositions of the convective layers. An analysis is performed on the influence of the assumed mixing length. The observational consequences of a possible mass loss are discussed for both the Red Giants and the Asymptotic branches. Possible causes for separation between these two branches are briefly examined. The case of the globular cluster ω Cen is investigated, in order to give some suggestions for a large dispersion in color observed among the giants belonging to this cluster. (auth)

24950 ELECTRIC CHARGE AND ACCELERATION OF SUPRATHERMAL GRAINS. Wickramasinghe, N. C. (University Coll. of South Wales and Monmouthshire, Cardiff (UK)). Astrophys. Space Sci.; 28: No. 2, L25-L29(Jun 1974).

Dust grains expelled from cool stars into the interstellar medium at speeds $\gtrsim 10^3$ cm s^{-1} are charged by secondary electron emission to potentials in the range 8-40 V. The conditions for the acceleration of such charged grains by the Fermi process are discussed. (auth)

24951 FE I FLUORESCENCE WITH ASTROPHYSICAL APPLICATIONS. Willson, L. A. M. Ann Arbor, MI; University of Michigan (1973). 46p. University Microfilms Order No. 74-3750.

Thesis (Ph. D.).

A statistical equilibrium analysis for the selective excitation of λλ4063, 4132 of FeI by CaII H shows: (a) selective excitation by CaII can reproduce the line intensities observed in T Tauri stars; (b) when enhanced λλ4063, 4132 emission is observed, an upper limit on the electron density as a function of distance from the star is obtained; (c) it is sometimes also possible to obtain an upper limit on the electron temperature and a lower limit on the electron density. Limits obtained for RW Aurigae are: $N_e/W \leq 10^{16}$ for $T_e = 3000°K$. N_e is too high unless $W \leq 10^{-8}$; thus $N_e \leq 10^8$ and the emission comes from 10^4 to 10^6 stellar radii out from the star. A probable characteristic of T Tauri stars is thus an extremely extended envelope. (Diss. Abstr. Int., B)

24952 EVOLUTION OF SUPERNOVA REMNANTS. Chevalier, R. A. Princeton, NJ; Princeton Univ. (1973). 110p. University Microfilms Order No. 74-9668.

Thesis (Ph. D.)

(I) The evolution of supernova remnants was studied by using a spherically symmetric hydrodynamic code with a magnetic field approximately included. Cooling by bremsstrahlung, line emission, and radiative recombination were included, and properties of the emitted radiation were investigated. Particular attention was paid to the late phases, when a dense neutral shell forms which accretes matter both from the interstellar medium and the hot interior. Interaction of the supernova shock with a large cloud decreases the total kinetic energy, and increases the thermal energy due to the reflected shock. The possibility that the initial supernova energy is deposited as relativistic particles is investigated; it is found that the shock radius a few thousand years after the explosion is fairly independent of the initial conditions, while differences when the radius is of order 1 pc are considerable. (II) Numerical models of the remnant of a strong explosion in or near the plane of the galaxy were computed, the density gradient out of the plane being taken into account. The blast energy tends to flow out of the plane, perhaps resulting in material escaping from the galaxy. Special attention was given to the evolution of a blast in an exponential atmosphere, which can be scaled to a range of initial parameters. A 10^{52}-erg explosion can accelerate on the order of 1000 $M_\odot$ to the heights and velocities required by the high-velocity clouds, but the surface density is a factor 100 too low. (RWR)

24953 3.5 MICRON LIGHT CURVES OF LONG PERIOD VARIABLE STARS. Strecker, D. W. Minneapolis; Univ. of Minnesota (1973). 260p. University Microfilms Order No. 74-10,595.

Thesis (Ph. D.).

Infrared observations at an effective wavelength of 3.5 μ of a selected group of long-period variable (LPV) stars are presented. Mira-type and semiregular stars of M, S, and C spectral classifications were monitored throughout the full cycle of variability. Although the variable infrared radiation did not exactly repeat in intensity or time, the regularity was sufficient to produce mean 3.5 μ light curves. For the M, S, and C stars as a group, the mean 3.5 μ alterations were about 0.7 m. The 3.5 μ maximum radiation lagged the visual maximum by about one-seventh of a cycle, while the minimum 3.5 μ intensity occurred nearly one-half cycle after infrared maximum. In some stars, there were inflections or humps on the ascending portion of the 3.5 μ light curve, which may also be seen in the visual variations. A color index [1.04 μ] − [3.5 μ] was formed. From the deduced color temperature the angular size of the source was calculated. Color temperatures, sizes, luminosities, visual magnitudes, and radial velocities were computed for the cool M giant variables over the entire cycle and compared with observational results. The color temperatures attain maximum coincidentally with visual maximum or zero phase, while the minimum is realized almost exactly one-half cycle later. Maximum compression occurs about one-tenth cycle before maximum temperature; maximum radius occurs about four-tenths of a cycle after minimum radius. Maximum luminosity happens about one-tenth cycle after maximum temperature and minimum energy output takes place nearly one-half cycle after maximum. The fractional change of temperature is about 20%; that of diameter is a little larger and the luminosity alters by a factor of two. (RWR)

24954 ALIGNED ROTATING MAGNETOSPHERES. Scharlemann, E. T. Ithaca, NY; Cornell University (1973). 107p. University Microfilms Order No. 74-10,199.

Thesis (Ph. D.).

The problem of finding a self-consistent steady-state axisymmetric solution for the electromagnetic field around a rotating, perfectly conducting star is considered, subject to the further simplifying assumptions that collisional, gravitational, and inertial forces are negligible. Inertial forces (still assumed small) are then included to determine the electron and ion velocities and densities uniquely. The basic equation for the magnetic field is derived, and found to be a quasi-linear elliptic partial differential equation when written as an equation for the poloidal magnetic potential A(r,z). The requirement that all physical field quantities remain nonsingular at the light cylinder specifies a set of boundary conditions which appear to be sufficient to determine unique solutions within the light cylinder. The solutions can then be extended beyond the light cylinder. The special case of constant current per unit poloidal magnetic flux is considered in detail; the equation for A(r,z) then becomes linear and separable in cylindrical coordinates. The general form of the solution for A(r,z), consisting of a sum over eigenfunctions of an equation for the separated function of r, is obtained; and the behavior of the eigenvalues and eigenfunctions is investigated. The ion and electron velocities are then considered along the polar field lines (which intersect the star near the rotation axis) by the inclusion of inertial forces to first order in the ratio of inertial to electromagnetic forces. A consistency equation for the velocities is obtained, subject to the constraints imposed by the current and charge density found in the lowest-order solution. The resulting particle accelerations and parallel electric field permit a determination of the limits of validity of the original assumptions. (Diss. Abstr. Int., B)

24955 NATURE OF THE CARBON STARS. Kilston, S. D. Los Angeles; University of California (1973). 126p. University Microfilms Order No. 74-3978.

Thesis (Ph. D.)

To investigate the means by which these stars have altered their surface compositions from the values found in most young stars, a detailed analysis of the spectra of eight representative N-type carbon stars was performed. High-dispersion yellow-red spectrograms of each star were analyzed by means of a Minneart-model spectrum synthesis of five wavelength regions, each about 20 Å wide. C_2 and CN molecular lines were included. Quite favorable agreement between the computed and observed spectra was obtained, even with the simple model. The main conclusion is that the carbon in N star surfaces originates from triple-alpha helium-shell burning, rather than from C−N−O equilibrium processes. With the assumption of solar oxygen abundance, the ratio C/O ranged from 1.033 for RZ Peg to 2.9 for V Aql, compared to the solar system value, 0.6. For these two stars the CN/C_2 ratios were, respectively, 200 and 4, ±40%. The Li abundances ranged from the meteoritic value to below the solar value. Zr turned out to be more abundant than in the solar system, by factors of 2 to 10, from the well-determined Zr/Ti ratios. The stars with less carbon seemed to have more Zr. Ba enrichment was found only in some of the high-Zr stars. Surface gravities ranged from log g = −0.3 to 1.7. Microturbulent velocities of close to 6 km/sec were required to fit the observed line profiles. (RWR)

24956 EXOTIC PHASES OF NEUTRON-STAR MATTER. Chao, N. C. Seattle, WA; Washington Univ. (1973). 132p. University Microfilms Order No. 74-7036.

Thesis (Ph. D.).

The possibility of a ferromagnetic transition in neutron matter is investigated by employing a t-matrix criterion for the onset of a ferromagnetic transition. It is found that the attractive component of the nuclear force is of crucial importance in neutron-matter ferromagnetism: it opposes the onset of ferromagnetism. The magnetic properties of neutron matter are further studied in the framework of a two-body Jastrow calculation. The results of the calculation for the energy of a system of neutrons with arbitrary spin polarization show that the antiferromagnetic state is energetically preferred to the ferromagnetic one. A calculation of a magnetic susceptibility provides further evidence that the ground state of neutron matter is antiferromagnetic. Isotropic proton superfluidity in neutron-star matter is investigated in the framework of the method of correlated basis functions. In the absence of polarization effects, $^1S_0$ proton pairing is found to be considerably weaker than $^1S_0$ neutron pairing. Isotropic proton

superfluidity (superconductivity!) is expected to prevail over a shell of considerable extent in the interior of a typical neutron star. At high densities, the possibility for neutron matter to assume a crystalline structure is examined on the basis of the quantum principle of corresponding states. From the density of the core-shifted hypothetical system, the density of the non-core-shifted neutron system is calculated by a simple geometrical correction. The procedure indicates that neutron matter may solidify at a rather low density, about 4×10^{14} g/cm^3, in a loosely-packed lattice structure. The energy per particle is about 20.5 MeV, and the solidification pressure is of the order 10^{27} atm. The interior of a typical neutron star, except for a thin layer of fluid, may be of entirely solid constitution. (RWR)

24957 ATMOSPHERE OF DELTA CEPHEI. II. Revised Abundance Analysis. Kobayashi, E.; Katahira, J. I. (Tohoku Univ., Sendai). Sci. Rep. Tohoku Univ., First Ser.; 56: No. 2, 17-35(Jul 1973).

High dispersion spectra taken at three phases of δ Cephei are analyzed by curve of growth method using new gf-values in revised scale. The results are as follows: (i) θ_{exc} close to θ_{eff} is obtained for Ti I and Fe I. (ii) Among 23 elements, the abundances of Ti and Fe in δ Cephei are about twice as much as those in the Sun. (auth)

24958 SEARCH FOR HIGH FREQUENCY OPTICAL VARIATIONS IN VELA XR-1. Hesser, J. E.; Lasker, B. M.; Miller, R. H. (Cerro Tololo Interamerican Observatory, La Serena, Chile). Nature (London); 248: No. 5448, 492(5 Apr 1974).

It is stated that the binary system associated with HD 77581, which is identified with the Vela x-ray source 2 U 0900-40, should be a good candidate for optical studies with high time resolution because of its relative brightness. Some data taken in February 1973 are here reported, using the Cerro Tololo 152 cm. telescope. Analysis showed no significant activity in the range 0.06 to 500 Hz, and no aperiodic variations are detected, except that at low frequencies increased variance ascribable to atmospheric scintillation was observed. (UK)

24959 NEUTRINOS IN ASTROPHYSICS. Omnes, R. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 10, 63-71(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

Neutrino production processes in astrophysics are reviewed together with the first negative results concerning the detection of solar neutrinos. (FR)

24960 CONTRIBUTION TO THE THEORY OF CHARGED PARTICLE ACCELERATION IN NONSTATIONARY MAGNETIC FIELDS. Bakhareva, M. F.; Lomonosov, V. N.; Tverskoy, B. A. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 653-659(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 769-776(1973).

The kinetic equation is used to investigate charged particle acceleration in nonstationary magnetic fields with scattering on hydromagnetic turbulence. An equation of particle diffusion in momentum space is obtained in the general form, and the relation of the Alfvén diffusion coefficient with the turbulence spectrum and the parameters of a nonstationary magnetic field is established. A self-consistent system of equations, describing the quasi-linear growth of oscillations and the relaxation of the distribution function under the effect of these oscillations, is formulated for finding the wave and particle spectra. The self-consistent system of equations is solved for ultrarelativistic electrons with allowance for magnetic bremsstrahlung. A conclusion is derived regarding the effective acceleration region, and the limits of application of the Alfvén acceleration mechanism are investigated. It is demonstrated that this mechanism, which provides for the observed power of synchrotron X-radiation, is applicable to the Crab nebula and the NP0532 pulsar. Estimates are given of several parameters of the plasma and radiation of these objects. (auth)

24961 CHANGES IN PHOTOMETRIC CHARACTERISTICS WITH THE PERIOD OF THE BLAZHKO-EFFECT IN RZ LYRAE. Romanov, Yu. S. (Odessa State Univ.). Astrometriya Astrofiz.; 18: 65-78(1973). (In Russian).

Three-color photoelectric observations of RZ Lyrae made during 1968–1970 were analyzed. RZ Lyrae has the peculiar Blazhko effect; i.e., the primary period is not changed with phase of Blazhko-effect period. Behavior of U_{max}, B_{max}, V_{max}, $(B-V)_{max}$, $(U-B)_{max}$, U_{min}, B_{min}, V_{min}, and $(B-V)_{min}$ was investigated. The relations of the maximum light amplitudes to the minimum ones $A_{U\,max} : A_{U\,min} = 1.89$, $A_{B\,max} : A_{B\,min} = 1.84$, $A_{V\,max} : A_{V\,min} = 1.97$ proved to be very close. (14 figures, 5 tables) (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 23851 and 24870.

24962 NATURE OF THE NEBULA SIMEIZ 59. Lozinskaya, T.A.; Esipov, V.F. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 17: No. 4, 449-451 (Jan 1974).

Spectroscopy and interferometry of Simeiz 59 (Sharpless 104) have yielded a radial velocity of +18±5 km/sec, (relative to the Local Standard of Rest) and an expansion velocity of 12±5 km/sec, values inconsistent with Milne's and Downes' interpretation of the nebula as a type II supernova remnant at distance 9–12 kpc. The nebula probably was formed through a type I supernova explosion in a dense interstellar gas cloud. The kinematic distance of the object is ≈3 kpc; its radius, 3 pc; its age, 10^5 yr. It resembles the nebula Simeiz 22, studied previously. Estimates of the magnetic-field strength and of the relativistic-electron number density in the proposed type I supernova remnants Simeiz 22 and 59 are similar to the parameters for the Tycho and Kepler type I remnants. (auth)

24963 STATISTICS OF CENTIMETER RADIO SOURCES OF MINIMUM FLUX DENSITY. Pariiskii, Y.N. (Special Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 4, 431-432 (Jan 1974).

From the Pulkovo measurements of the background brightness fluctuations at 4-cm wavelength, the behavior of the curve for the logarithmic number of sources against the logarithmic flux density is established for sources as weak as 1.9×10^{-29} Wm^{-2}Hz^{-2} No evolutionary effects are detected. (auth)

24964 COUNTS OF RADIO SOURCES AT 86-MHz FREQUENCY I. REDUCTION PROCEDURE FOR A SURVEY WITH THE EAST-WEST ARRAY OF THE DKR-1000 RADIO TELESCOPE. Artyukh, V.S.; Dagkesamanskaya, I.M. (Lebedev Physics Institute, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 4, 433-437 (Jan 1974).

A procedure is described for reducing observations made in a survey of radio sources with the east-west array of the DKR-1000 radio telescope. The choice of an optimum reduction algorithm is substantiated, and the operation of a computer program following this algorithm is explained. The maximum-likelihood method is adopted for the detection of sources. (auth)

24965 DISTRIBUTION OF INTERSTELLAR HYDROXYL IN THE CYGNUS X REGION. Pashchenko, M.I. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 17: No. 4, 438-442 (Jan 1974).

The Cyg X region was observed in the 1667-MHz OH lines with the Nançay radio telescope during March-May 1972. The sources DR 6,7,9,11,12,15, 18, and 19 and G78.6+1.0 exhibit OH absorption. Their optical thickness is 0.01–0.035. In the DR 21 neighborhood, absorption has been measured independently in DR 20,22 and in DR 21,23. Strong OH absorption is found in W 75 (DR 21) at small negative radial velocities relative to the Local Standard of Rest. At $\simeq 10^3$ cm^{-3}, containing a compact H II zone in DR 21 and the W 75 source of maser drogen concentration of $\simeq 10^3$ kpc, containing a compact H II zone in DR 21 and the W 75 source of maser OH and H_2O emission. At 4–5 kpc from the sun a normal OH cloud is present, with a mean optical thickness of 0.025; its mean gas density is $\simeq 1$ cm^{-3}. (auth)

24966 POLARIZATION OF INVERSE PLASMON SCATTERING. Windsor, R.A.; Kellogg, P.J. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). Astrophys. J. 190: No. 1, 167-173 (15 May 1974).

The scattering of electrostatic plasma waves by a flux of ultrarelativistic electrons passing through a plasma gives rise to a radiation spectrum which is similar to a synchrotron radiation spectrum. This mechanism, first considered by Gailitis and Tsytovich, is analogous to inverse Compton scattering, and we have named it inverse plasmon scattering. For a power-law electron flux, both inverse plasmon scattering and synchrotron radiation have the same spectral index. In an attempt to distinguish between these mechanisms, we have calculated the polarization level expected from inverse plasmon scattering. The polarization level found is similar to that obtained from a synchrotron radiation source. This means that the radiation produced by the two mechanisms, synchrotron radiation and inverse plasmon scattering, is indistinguishable; and this attempt to differentiate between them by polarization effects has been unsuccessful. (auth)

24967 SPECTROSCOPY OF OBJECTS NEAR TEXAS RADIO-SOURCE POSITIONS. Wills, D.; Wills, B.J. (McDonald Observatory and University of Texas Radio Astronomy Observatory, University of Texas at Austin). Astrophys. J. 190: No. 2, 271-277 (1 June 1974).

Spectroscopic obersvations of 62 objects near accurate Texas radio-source positions are reported. Among a sample of 17 blue stellar objects within 3″ of the Texas radio positions all 17 are found to be QSOs, confirming the expected high reliability (95 percent) of such identifications. A further seven QSOs, and two stars, are found among nine blue stellar objects lying between 3″ and 5″ of the radio positions. Observations of 12 red and neutral stellar objects within 5″ of Texas, and other, accurate radio positions show two of them to be QSOs and three to be rather luminous galaxies, comparable with low-luminosity QSOs. New redshifts are given for 30 QSOs and galaxies. (auth)

24968 ASTROPHYSICAL MASERS. IV. LINE WIDTHS. Goldreich, P.; Kwan, J. (California Institute of Technology, Pasadena). Astrophys. J. 190: No. 1, 27-34 (15 May 1974).

The standard theory of maser line widths predicts line narrowing during unsaturated amplification and rebroadening to the full Doppler width during saturated amplification. These predictions conflict with the observations of narrow maser lines from sources which appear to be saturated. In an attempt to resolve this conflict, a new theory of maser line widths is developed which takes into account effects arising from infrared line radiation trapped between the molecular levels. It is shown that if a series of infrared lines connects the upper and lower maser levels, line rebroadening during saturated amplification does not occur provided that each infrared transition satisfies $A/[\exp(h\nu/kT)-1] \gg R$, where A and ν are respectively the spontaneous emission rate and transition frequency of the infrared line, T is the kinetic temperature, and R is the stimulated emission rate across the maser levels. In fact, under these conditions, the maser line continues to narrow during saturated amplification since the gain profile is not affected by saturation. (auth)

24969 OPTICAL POLARIZATION OF THE CRAB NEBULA PULSAR. III. NEW OBSERVATIONS, PREDICTIONS, AND THE POSSIBILITY OF VARIABILITY. Ferguson, D.C.; Cocke, W.J.; Gehrels, T. (University of Arizona, Tucson, Arizona 85721). Astrophys. J. 190: No. 2, 375-380 (1 June 1974).

New and very precise measurements of the optical polarization of the Crab Nebula pulsar are presented. Better fits by the relativistic vector model than were previously reported are possible due to an improved method of plotting the data. A prediction of the true polarization arising outside the pulsar is made. The possibility of secular changes in the pulsar's polarization is discussed. (auth)

24970 PULSAR MAGNETIC AXIS ALIGNMENT AND COUNTERALIGNMENT. Macy, W.W. Jr. (Princeton University Observatory, Princeton, New Jersey). Astrophys. J. 190: No. 1, 153-163 (15 May 1974).

A model is proposed for the alignment or counteralignment of the magnetic axis of a pulsar with its symmetry axis by the motion of the magnetic distortion through the star due to the same kind of secular instability that has been proposed to cause polar wandering on the Earth. The evolution of various observable characteristics is determined by simultaneously integrating the equations for the rate of change of magnetic-axis inclination and for the angular momentum. The observable parameters calculated for aligning models are found to be similar to those of Type D pulsars while parameters calculated for counteraligning models are similar to those of Type C pulsars. Type S pulsars will evolve into Type C or Type D pulsars but have not yet significantly aligned or counteraligned. The damping time of the precession about the average rotation axis is considered for two different crust materials. For one crust material the damping time is found to be greater than the braking time while for the other it is found to be on the order of the precession period which is much less than the braking time. (auth)

24971 OBSERVATION OF X-RAY EMISSION FROM M31. Bowyer, S.; Margon, B.; Lampton, M.; Cruddace, R. (Space Sciences Laboratory and Department of Astronomy, University of California, Berkeley). Astrophys. J. 190: No. 2, 285-289 (1 June 1974).

We have observed X-ray emission from M31 in the 0.5-5.0 keV band, using rocket-borne proportional counters. The integrated flux corresponds to $(2.2 \pm 0.6) \times 10^{39}$ ergs s^{-1} at M31, and is confined chiefly to a region coinciding with the optical image of the galaxy. The spectrum has a slope similar to the bright Galactic X-ray sources. The intensity, spectral, and spatial data suggest that the bulk of X-ray emission from M31, and by inference from most normal galaxies, is due to a small group of highly luminous sources, in agreement with the Galactic X-ray luminosity function. (auth)

24972 DETECTION OF SOFT X-RAY EMISSION FROM PSR 0833-45. Culhane, J.L.; Cruise, A.M.; Rapley, C.G.; Hawkins, F.J. (Mullard Space Science Laboratory, Department of Physics and Astronomy, University College London). Astrophys. J. Lett. 190: No. 1, L9-L22 (15 May 1974).

An observation of the Vela pulsar in the energy range 0.7-1.5 keV is presented. A comparison of the flux in this band with the spectrum of the source 3U 0833-45 for the 2-10 keV band suggests a low-energy turnover in the spectrum. The measurement is compared with other observations, and possible explanations of the turnover are discussed. (auth)

24973 NONPERIODIC OPTICAL FLICKERING IN HZ *HERCULIS*. Moffett, T.J.; Nather, R.E.; Vanden Bout, P.A. (The University of Texas at Austin and McDonald Observatory). Astrophys. J. Lett. 190: No. 2, L63-L66 (1 June 1974).

High-speed simultaneous dual-channel photometry of HZ Her and a nearby comparison star reveal nonperiodic optical flickering in the HZ her system on a time scale of 15-300 s. The amplitude of the flickering appears to be correlated with orbital phase. Optical emission from a hot spot in a disk of material around the X-ray source cannot account for the flickering. (auth)

24974 THE ABSENCE OF RADIO EMISSION FROM HZ HERCULIS. Hartmann, L. (Department of Astronomy, University of Wisconsin, Madison, Wisconsin 53706); Lapedes, A.S. Astrophys. J. Lett. 190: No. 2, L67-L68 (1 June 1974).

The absence of pulsed emission in HZ Herculis at 430 MHz found in this study is consistent with current theoretical models. However, the absence of a radio halo or supernova remnant emitting continuum radiation indicates either that the pulsar is more than 10^5 years old, or that there was no supernova remnant associated with the pulsar's birth. (auth)

24975 THE SPECTRUM OF DIFFUSE COSMIC X-RAYS OBSERVED BY OSO-3 BETWEEN 7 AND 100 keV. Schwartz, D.A. (American Science and Engineering, Cambridge, Massachusetts 02139); Peterson, L.E. Astrophys. J. 190: No. 2, 297-303 (1 June 1974).

The shape of the diffuse X-ray spectrum in the 1-100 keV range has important implications regarding its origin and its possible connection with the diffuse γ-rays measured at higher energies. Previous results have suggested that the spectrum decreases with energy more rapidly in the 30-100 keV interval than in the 2-10 keV interval. However, the OSO-3 X-ray detector, covering the 7.7-210 keV range with an area of 9.57 cm^2, and collimated to a 12° half-angle field of view, has provided the only data from a single instrument which could not be fitted by a single power-law spectrum even over the limited range of that instrument. In this paper we consider the effects of long-lived induced radioactivity, energy dependence of the effective aperture, and fluorescence radiation from the shield on our previous estimate of the diffuse X-ray counting rates observed from OSO-3. We confirm our previous conclusion that the spectral data cannot be represented by a single power-law function. A sharp discontinuity between two power-law indices suffices for a minimum-parameter representation of the data. However, our results are also consistent with a continuous change of slope between 7 and 100 keV. (auth)

24976 MULTIPLEX METHODS AND ADVANTAGES IN X-RAY ASTRONOMY. Palmieri, T. M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service d'Electronique Physique). Astrophys. Space Sci.; 28: No. 2, 277-287(Jun 1974).

The Multiplex Advantage is defined and applied in considering various techniques presently used in x-ray astronomy. It is concluded that the multiplex advantage will be useful in evaluating future techniques to be used in x-ray astronomy. (auth)

24977 MODELS OF COMPACT X-RAY SOURCES. Katz, J. I. Ithaca, NY; Cornell University (1973). 204p. University Microfilms Order No. 74-6382.

Thesis (Ph.D.).

Detailed models to explain the complex observations of compact x-ray sources are discussed. A vibrating white dwarf has been proposed as the origin of the regular pulsations with periods of 4.84 seconds in Cen X-3 and 1.24 seconds in Her X-1. This proposal is studied with a numerical hydrodynamic calculation of the atmosphere of a vibrating white dwarf. It is found that this model falls several orders of magnitude short of the observed x-ray powers, and also has the wrong x-ray spectrum and pulse shape. A model for the regular "35 day" high-low intensity cycle of the source Her X-1 is proposed. The optical extinction to Sco X-1 is proposed to be larger than the usually accepted value. Then the optical continuum no longer has a thin-bremsstrahlung spectrum, and mass-transfer binary models become more reasonable. The optical continuum comes from the x-ray-heated photosphere of a normal low mass star, while the x rays come from an accretion disc. (RWR)

24978 PULSAR ELECTRODYNAMICS. Hinata, S. Urbana, IL; University of Illinois (1973). 67p. University Microfilms Order No. 74-5592.

Thesis (Ph.D.).

It is usually assumed that the pulsar atmosphere consists of an open and a closed magnetosphere. There is, however, no gen-

erally accepted theory which predicts the boundary between these two regions. Contrary to the expectation that the inertial effects would play the crucial role in determining this boundary, the critical radius $R_c = (\Omega R/c)^{-\frac{1}{3}}$ beyond which the lines of force are open, is obtained from the analysis of a corotational atmosphere, which is valid only in the absence of the inertial effects. Some of the processes underlying the theory of pair production and subsequent radio wave emission about a pulsar are also studied. The behavior of charges in a self-consistent electric field in the presence of the poloidal current about an aligned magnetic rotator is investigated. The energy of a charge is obtained as a function of distance along the trajectory, with radiation reaction taken into consideration. It is shown from this that the curvature radiation loss dominates the kinetic energy loss in the vicinity of the star, if the radiation reaction limits the energy of the charge within approximately one stellar radius. The luminosity is then obtained as $L^* = (1/64)B_0^2\Omega R^3 (\Omega R/c)^{4n}$, regardless where the radiation reaction limits the energy of the charge. The braking index for an aligned rotator is obtained as $n = 2.2$. The surface magnetic field strength is also estimated as $B_0 = 10^{10} \sim 10^{12}$ gauss from the observation of luminosity. The spectrum of the curvature radiation and the assumed magnetic field configuration enable an estimate of how many pairs are produced per second, where they are produced, and the criterion for the pair production to take place, $B_{11}T_8^{-25/35} R_8^{33/35} \gtrsim 2.5$. It is found from this that the pair production is likely to take place around PSR 531, 833, and 525. (Diss. Abstr. Int., B)

24979 RADIO OBSERVATION OF THE X-RAY SOURCE SCO-X-1. Kawano, N.; Kawajiri, N.; Ojima, T. (Radio Research Lab., Kashima, Japan). Denpa Kenkyusho Kiho; 19: No. 102, 157-162(May 1973). (In Japanese).

Radio observations of the x-ray object Sco-X-1 were carried out with Kashima 26mϕ antenna for five hours a day from April 16 through 19, 1972. X-ray and optical intensity measurement of Sco-X-1 was also made by Matsuoka, et al. in Hyderbad, India, at about the same time as the radio observations. The radio flux intensity of Sco-X-1 reached a value of 0.11 ± 0.03 f.u. (1 f.u. = 10^{-26} W · m^{-2} · Hz^{-1}) on April 19, whereas it was 0.03 ± 0.023 f.u. on April 18. This flare-up of radio emission is large compared with the previous results. At that time, optical intensities remained rather strong (probably smaller than 12.4 mag), and x-ray intensities showed no remarkable change. The observed x-ray emissions of energy range from 20 to 40 keV indicate the spectrum of bremsstrahlung from hot and optically thin plasma. In order to explain the optical intensity, estimation from the theory of bremsstrahlung must be modified by free–free absorption, Thomson scattering and interstellar extinction of about one magnitude. For radio range of the spectrum, however, the theoretical intensity is far greater than the observed one. The electron density obtained through the soft x-ray data corresponds to a plasma frequency much larger than the observational frequency. If it is assumed that the radio emission comes from the same region as optical and soft x-ray data for the object, the radio brightness temperature becomes an improbable value of 10^{16}°K. These facts show that the region emanating radio emission differs from that producing both optical and soft x-ray emission, and radio emission must be radiated from the small density region and be due to the mechanism effective in the radio spectrum. (auth)

24980 RADIO SOURCES WITH LOW FREQUENCY CUTOFFS. Ross, H. N. Toronto; Univ. of Toronto (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

About 100 radio sources outside the galactic region which exhibit low-frequency cutoffs in their spectra were investigated. In particular, observations were carried out at 2.8 cm, 4.5 cm, 9.3 cm, 21 cm, and 40 cm. Each source was observed on several epochs at the shorter wavelengths so that time variations could be studied. The positional data were sufficiently precise that optical identifications could be attempted. An observing and data reduction technique was developed that provided flux density results a factor of three to five times more precise than was previously produced for radio sources of this class. A step in this technique yielded accurate high-frequency spectra for a number of sources commonly used by astronomers as standards. The results generally indicate that the spectra of the low-frequency cutoff sources observed are complex, often containing three or more spectral components. In addition, virtually all of the sources studied are significantly variable in flux density in time scales shorter than a year and a half, and many sources show very large flux-density variations on even shorter time scales. The optical identification work indicates that a considerable fraction of the sources correspond to blue stellar objects on the Palomar Sky Survey plates, although most of the sources appear to be associated with small diffuse objects, both red and blue. A startling discovery was that spatial structure—on a scale of several minutes of arc and often variable—was found for many of the sources. The interpretation of this result is discussed in terms of a model. A brightness temperature relation was developed that enabled the angular diameter, magnetic field, electron density, and linear extent to be calculated for components of all the sources with respect to different physical mechanisms. As a result, it was concluded that synchrotron self absorption was the most likely cause of the low-frequency cutoffs for these objects. (Diss. Abstr. Int., B)

24981 FREE PRECESSION OF NEUTRON STARS. Pines, D.; Shaham, J. (Univ. of Illinois, Urbana). Nature (London); 248: No. 5448, 483-486(5 Apr 1974).

It is stated that detection of free precession is one of the most promising methods for determining the mass and internal structure of neutron stars. The free precession frequency differs by several orders of magnitude according to whether the star has a solid or a liquid core. Ways of exciting and maintaining such precession, and damping mechanisms are here considered. It is concluded that the "wobble" in pulsars can provide a clue to the structure and properties of the star, and that crust–liquid coupling is probably the principal source of "wobble" damping, and "wobble" excitation is more easily set up in a comparatively young rapidly rotating neutron star. Analogies with terrestrial "wobble" are discussed; in a pulsar there is an additional mechanism that might be responsible for exciting "wobble"—the radiation torque associated with the pulsar magnetic field. Prospects for observing "wobble" effects are discussed. (UK)

24982 RADIO SOURCE IDENTIFIED WITH A NEUTRAL STELLAR OBJECT NEAR AN UNUSUAL GALAXY. Murdoch, H. S.; McAdam, W. B.; Hunstead, R. W. (Univ. of Sydney). Nature (London); 248: No. 5448, 491-492(5 Apr 1974).

It is stated that recent improvements in the accuracy of location of radio source positions to 1 arc sec have made possible the reliable identification of a number of radio sources with stellar objects of neutral color (NSO's). Identification of an NSO of 19 mag with a radio source is here reported, close to an unusual blue galaxy. The source differs in one important aspect from most NSO's identified with radio sources in that it shows a steep radio spectrum with spectral index 0.99 ± 0.07. This is probably a result of the nearby occurrence of 1108 + 034 (4C 03.21) and 1107 + 045 (4C 04.35). It is stated that the nearby blue galaxy is an interesting object in its own right, and some of its features are described. (UK).

Solar Phenomena

Refer also to abstracts 23506, 24877, 24918, 25128, 25159, and 25553.

24983 (AD–775743/8) MILLSTONE HILL INCOHERENT SCATTER OBSERVATIONS OF THE IONOSPHERIC RESPONSE TO THE SOLAR FLARE OF 7 AUG 1972. Mendillo, M.; Evans, J. V. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 6 Nov 1973. 27p. (AFCRL-ERP-458; AFCRL-TR–73-0686). NTIS $4.50.

The Millstone Hill incoherent scatter radar was in operation during the important 3B solar flare which occurred at 15:00 UT on 7 August 1972. Measurements of the electron density profile were made over the height range of 125 to 1200 km, together with observations of the electron temperature, ion temperature, and vertical drift velocity above 225 km. The ionospheric NE(H) profiles obtained span the largest height range ever studied during flares, while the temperature and drift data represent the first measurements of these parameters ever made under flare conditions. In discussing the overall results obtained during this event, estimates are made of the flare-induced electrodynamic and thermal processes which contribute to the observed effects. (auth)

24984 (AD–775745/3) PHOTOELECTRIC PHOTOMETER FOR THE FE XIV SOLAR CORONA. Fisher, R. R. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 9 Nov 1973. 15p. (AFCRL-IP–205; AFCRL-TR–73-0696). NTIS $4.00.

A photoelectric photometer for the emission line 5303 (FE XIV formed in regions where TE = 2.0 × 10 to the 6th power degrees K) of the solar corona is described in this paper. The emission line is isolated from the scattered light of the sky and the instrument by means of a rapid change in the bandpass of a birefringent filter. A piezoelectric variable retarder is used to accomplish the bandpass modification as a 100 kHz rate. The

instrument is capable of detecting the corona in scattered light situations that exceed the maximum allowed for filter photography by a factor of 10; thus, the number of hours during which coronal observations can be made with the photoelectric instrument is significantly larger than the photographic method presently used. An example of synoptic observations of the FE XIV corona is presented. Spatial resolution achieved is limited by the scan stop in the image plane and is 1.1 arc minutes. Scans are made in position angle, holding the scan distance from the limb a constant. The FE XIV signal is detected out to a distance of 1.55 R/RO above the limb. (auth)

24985 (AD-776251/1) SHORT DURATION SOLAR MICROWAVE BURSTS AND ASSOCIATED SOFT X-RAY EMISSION. Spangler, S. R.; Shawhan, S. D. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Dec 1973. Contract N00014-68-A-0196-0003. 41p. NTIS $3.25.

Using a combination of ground-based and satellite instrumentation, solar flares are being studied over a wide range of wavelengths from radio through optical to x-ray. The purpose of this report is to further delineate parameters about the association of 2-12 a soft x-ray bursts with short duration 15 GHz microwave bursts. In the time period between November 1968 and March 1970, 147 cases of coincident microwave and x-ray flares have been examined to determine the relationships of start times, time of maxima, flux, and energy. (GRA)

24986 (N-71-34954) MAGNETIC FIELDS, BREMSSTRAHLUNG, AND SYNCHROTRON EMISSION IN THE FLARE OF OCTOBER 24, 1969. Zirin, H.; Pruss, G.; Vorphal, J. (Hale Observatories, Pasadena, Calif. (USA)). 1971. Contract NAS5-9094. 19p. (NASA-CR-121620). NTIS.

The investigation of an impulsive flare on October 24, 1969 which produced two bursts with virtually identical time profiles of 8800 MHz emission and X-rays above 48 keV is reported. The two spikes of hard X-rays correspond in time to the times of sharp brightening and expansion in the H-alpha flare. The first burst was not observed at frequencies below 3000 MHz. This cut off is ascribed to plasma cut off above the low-lying flare. A model of the flare based on H-alpha observations shows that the density of electrons with energy above 10 keV is 5×10 to the 7th power if the field density is 10 to the 11th power. The observed radio flux would be produced by this electron distribution with the observed field of 200 gauss. The H-alpha emission accompanying the hard electron acceleration is presumed due to excitation of the field atoms by the hard electrons. (auth)

24987 (N-73-30775) SUNSPOT MOTION AND FLARING IN M482. Lazareff, B.; Zirin, H. (Hale Observatories, Pasadena, Calif. (USA)). 1971. Contract NSR-05-002-071. 18p. (NASA-CR-133848; BBSO-130). NTIS $3.00.

A series of flares was studied in McMath 11482 August 19-22, 1971, with particular reference to the basis for the flares and comparison with dekameter radio data. The flares were produced by rapid (approximately 1000 km/hr) westward motion of a large new p spot. Many flares occur just in front of the spot, and they cease when the motion stops. All flares occurring in front of the spot produce type III bursts, while even strong flares elsewhere in the region produce little or no type III. The time of type III emission agrees perfectly with the start of the H alpha flare. Thus type III bursts are only produced in favorable configurations. Simultaneous K-line movies are compared with H alpha films and show little difference in flare appearance. (auth) (STAR)

24988 SOLAR TEMPERATURE AND OXYGEN ABUNDANCE DETERMINED FROM OXYGEN LINES. Delone. A.B.; Zakharova, A.L.; Sitnik, G.F. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 50: No. 4, 557-558 (Jan 1974).

From equivalent widths of λλ 6364, 6300, 5577 [O I] and the infrared λλ 7772/74/75[O I] triplet measured on photoelectric tracings of the sun, the temperature of the emission layer is found to be 5000 ± 170°K and the O abundance $N = (6.3 \pm 0.1) \cdot 10^{20}$ cm^{-2}. Effects from blends with Ni lines, the C_2 molecule, and daylow O emission are analyzed and taken into account. (auth)

24989 ELECTRON TEMPERATURE OF SOLAR REGIONS WHERE RECOMBINATION CONTINUA ARE FORMED. TEMPERATURE OF CARBON EMISSION REGIONS. Gulyaev, R.A. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 4, 503-505 (Jan 1974).

A procedure for determining the electron temperature from the intensity distribution in the recombination continuum is given in a general form applicable to radiation by the atoms of any element. The OSO-4 data[3] for the CI recombination continuum of the quiet sun yield an electron temperature $T_e = 7100 \pm 500$°K for the carbon emission regions in the solar atmosphere. It has previously been found that $T_e = 8300$°K for hydrogen[4] and 12,500°K for helium[5]. (auth)

24990 PARAMETERS OF SOLAR U-BURST SOURCES. Fomichev, V.V.; Chernov, G.P. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 4, 506-510 (Jan 1974).

An attempt is made to determine the parameters in the emission region of a solar U burst on the basis of simultaneous spectrographic and polarimetric observations of a burst on June 10, 1969. Waldmeier's coronal-condensation model is employed to derive the trajectory of the exciting source, whose transverse diameter is estimated to be $\simeq 4 \cdot 10^3$ cm. The variation in the magnetic-field strength along the trajectory through the corona is calculated, assuming that the polarization of the radio emission results from the circumstances of propagation and escape of the radio waves. The field grows from $\simeq 1$ gauss at the beginning of the trajectory to $\simeq 8$ gauss at the end. It is concluded that U bursts are generated by beams of lower-energy particles than type III bursts, but they travel through stronger magnetic fields. (auth)

24991 GENERATION OF TYPE IV DECIMETER BURSTS IN THE SOLAR CORONA. Akin'yan, S.T. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 4, 511-517 (Jan 1974).

The following properties of type IV decimeter bursts are established from published observations of solar radio bursts during 1959-1969. 1) Large decimeter bursts occur in the eastern and central regions of the solar disk; 2) the distribution of such events across the disk exhibits a deep minimum at longitudes 30-50° W; 3) the flux density of the radiation at low frequencies falls off sharply with increasing longitude of the corresponding flare, while at high frequencies it rises significantly; 4) the frequency at which the polarization of a burst reverses sign increases with the heliographic longitude of the burst source. These properties can be explained satisfactorily by assuming that the burst sources have a double structure and are located in the magnetic field (decreasing with height from ≃200 to 100 gauss) of active regions in the corona during certain events. Electrons with an energy of tens of keV and a density $\gtrsim 10^3$ cm^{-3} are required to generate the bursts. The radiation is strongly absorbed along its path by thermal electrons in the resonance layers $\omega = s\omega_H$. (auth)

24992 DEPENDENCE OF SOME CHARACTERISTICS OF NOISE STORMS ON THE SOLAR ACTIVITY CYCLE. Korolev, O.S. (Institute of Geomagnetism, the Ionosphere, and Radio Wave Propagation, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 4, 518-523 (Jan 1974).

A statistical treatment was applied in interferometric observations of noise storms at 169 MHz (Nancay Observatory) from 1957 to 1970 and optical data of solar activity for the same period which shows some basic properties of noise storms over a full cycle of solar activty (mean intensity, number of storms per year, etc.). The connection between the basic properties of noise storms over a full cycle of solar activity (mean storms is studied. It is established that noise storms with an initial given probability arise over large spots during the maximum activity phase and that the required area of the spots decreases to small values at the activity minimum. Estimating the field intensity from spots of different areas at the level of an ordinary wave $v = 1$ from the dipole law, and considering that the density of the solar corona at a fixed altitude varies with the phase of the cycle, it is found that the ratio of the magnetic field intensity to the electron concentration in the region of noise stroms generation has a slight dependence on the solar cycle ($\alpha = \omega_H/\omega_0 \simeq$ const) for a fixed probability. Some properties of the radio emission of noise storms are discussed on the basis of the conclusion obtained. (auth)

24993 NORTH—SOUTH ASYMMETRY OF THE INTERPLANETARY MAGNETIC FIELD. Kovalenko, V.A. ; Longinov, V.F.; Malyshkin, V.N. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation, Siberian Branch, Academy of Sciences of the USSR). Sov. Astron.-AJ 50: No. 4, 524-526 (Jan 1974).

A discussion is given of high-velocity solar-wind flow with increased thermal pressure prependicular to the ecliptic plane. Such a flow will produce a north—south component in the interplanetary magnetic field with the field near the earth's orbit deflected, on the average, in the direction of the less active solar hemisphere. This effect is inferred both from analyses of the arrival of solar cosmic rays and from direct measurements of the solar plasma. (auth)

24994 NONGRAVITATIONAL EFFECTS ON THE EVOLUTION OF DUST PARTICLES MOVING IN ELLIPTIC ORBITS ABOUT THE SUN. Dobrovol'skii, O.V.; Egibekov, P.; Zausaev, A.F. (Institute of Astrophysics, Academy of Sciences of the Tadzhik SSR, Dushanbe). Sov. Astron.-AJ 50: No. 4, 527-528 (Jan 1974).

An analysis is made of the combined influence of the Poynting–Robertson effect, corpuscular drag, vaporization, and sputtering on the evolution of an elliptical dust-particle orbit. Particles similar to terrestrial rocks with an initial radius of 10^{-4} cm and an orbit for which $a \simeq 1$ a.u. and $e \simeq 0.5$ will approach the sun along elliptical spirals with nearly constant e. The disintegration of a particle will greatly shorten the time it spends in the vicinity of the sun before it is ejected by radiation pressure. (auth)

24995 THE SOLAR WIND He^{2+} TO H^+ TEMPERATURE RATIO. Feldman, W.C.; Asbridge, J.R.; Bame, S.J. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). J. Geophys. Res. 79: No. 16, 2319-2323 (1 June 1974).

The Los Alamos Scientific Laboratory Imp 6 solar wind ion plasma data measured between March 18, 1971, and May 30, 1972, were searched for a dependence of the alpha particle to proton temperature ratio T_α/T_p on the ratio of the solar wind expansion scale time to the Coulomb collision energy transfer time τ_s/τ_c. For flow conditions characterized by nearly Maxwellian ion velocity distributions, T_α/T_p is observed to vary inversely with τ_s/τ_c when τ_s/τ_c is small, $T_\alpha/T_p \simeq 4$, and when $\tau_s/\tau_c \gtrsim 1$, $T\alpha/T_p \lesssim 2$. This result is consistent with a simplified model of the solar wind ion thermal state in which the dominant ion heating mechanisms active close to the sun are capable of maintaining T_α/T_p in the neighborhood of 3.25 out to some radial distance. $R_c \simeq 0.2$–0.5 AU. For flow conditions characterized by sufficiently high N_p and/or sufficiently low $T_p + T_\alpha/4$ the relative alpha particle proton heating effects of these mechanisms become dominated by Coulomb energy transfer collisions, which reduce T_α/T_p toward unity. (auth)

24996 PROPAGATION OF TRANSVERSE WAVES IN A RADIALLY EXPANDING PLASMA. Solodyna, C.V.; Belcher, J.W. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology Cambridge, Massachusetts 02139). J. Geophys. Res. 79: No. 16, 2297-2301 (1 June 1974).

We have investigated the properties of low-frequency transverse waves in an expanding plasma. The wave vector k, the background magnetic field B, and the streaming velocity of the plasma V are all assumed to lie along the radial direction. We present expressions for the radial dependence of the amplitude and phase of left and right circularly polarized waves, correct to first order in the wave frequency divided by the proton cyclotron frequency. Differences in the phase velocities of these two circular polarizations result in a Faraday rotation that can be substantial for typical interplanetary conditions near 1 AU. We also consider the implications of these results for a realistic solar wind model with the interplanetary magnetic field along the spiral direction. (auth)

24997 HYDRAULIC CONCENTRATION OF MAGNETIC FIELDS IN THE SOLAR PHOTOSPHERE. I. TURBULENT PUMPING. Parker, E.N. (Department of Physics, Department of Astronomy and Astrophysics, University of Chicago, Chicago, Illinois 60637). Astrophys. J. 189: No. 3, 563-568 (1 May 1974).

Observations suggest that most of the magnetic flux through the solar photosphere is concentrated in vertical filaments in the supergranule boundaries. Each filament appears to contain about 3×10^{18} maxwells, in the form of a field of 500 gauss or more, over a diameter of 700 km or less. The magnetic energy density in the filaments is 100 times the observed kinetic energy density of the observed supergranule motions, but comparable to the kinetic energy density of the granules. Force-free field configurations cannot duplicate the observational numbers, nor can such cooling effects as are believed responsible for the intense fields in sunspot umbrae. We point out a simple hydraulic mechanism—turbulent pumping— that appears to account for the observed concentration of fields. The mechanism is treated by using the simple mixing-length theory of convection and turbulence. (auth)

24998 FACULAE AND THE SOLAR OBLATENESS. II. Dicke, R.H. (Joseph Henry Laboratories, Physics Department, Princeton University, Princeton, N.J. 08540). Astrophys. J. 190: No. 1, 187-198 (15 May 1974).

Chapman and Ingersoll have suggested that the presence of a normally distributed error in their facular function may require a large increase in the estimate of the photospheric facular contribution to the solar oblateness signal. This effect is evaluated by using the Chapman–Ingersoll statistical assumptions and additional facular data from earlier studies. With further assumption that there is no common systematic bias between the two facular signals, the above effect is found to be negligible, representing an additional 2–3 percent correction to the oblateness signal. The effects of systematic biases of the facular data are also examined. (auth)

24999 THE DIFFERENTIAL ROTATION OF THE SOLAR SURFACE. Gierasch, P.J. (Center for Radiophysics and Space Research, Cornell University, Ithaca, New York 14850). Astrophys. J. 190: No. 1, 199-210 (15 May 1974).

The large-scale flow in the solar convection zone is discussed. The objective is to deduce from observation the principal physical balances in the governing equations. The simplest set of equations that seem potentially realistic are utilized. It is assumed that magnetic fields are negligible, that mixing-length theory gives an accurate representation of the mean structure, and that rigid-body rotation exists at the base. It is deduced that the zonal flow is geostrophic, the meridional flow is controlled by friction, and diffusive heating balances advective cooling due to vertical motion. Next, a detailed calculation of the latitude profile of surface angular velocity is performed, based on approximate equations containing only the principal balances, and agrees well with observation. Finally, it is demonstrated that the amplitude of the flow may be determined by the constraint that the net equatorward angular momentum flux vanish. The conclusions are consistent with the hypothesis that the flow is primarily a single large axisymmetric convection cell in each hemisphere. There is contradiction with the observation of no equator–pole flux variation, but this may be due to oversimplification of equations and boundary conditions. (auth)

25000 ON THE SUN'S DIFFERENTIAL ROTATION: ITS MAINTENANCE BY LARGE-SCALE MERIDIONAL MOTIONS IN THE CONVECTION ZONE. Durney, B.R. (Advanced Study Program, National Center for Atmospheric Research, Boulder, Colorado 80302). Astrophys. J. 190: No. 1, 211-221 (15 May 1974).

It is shown that if the observed differential rotation of the Sun is generated in the lower, Boussinesq part of the convection zone (where the interaction of rotation with convection is important), a large pole–equator difference in flux would also have to be present. The Sun's angular velocity is evaluated as a function of depth and latitude under the assumption that the main effect of the interaction of rotation with convection is the generation of a small pole–equator difference in temperature in the lower part of the convection zone, which drives a meridional motion over the entire convection zone. The pole–equator difference in flux associated with this meridional circulation (which gives rise to the Sun's differential rotation) is negligible. (auth)

25001 STABILIZATION OF ELECTRON STREAMS IN TYPE III SOLAR RADIO BURSTS. Papadopoulos, K. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Maryland 20742); Goldstein, M.L.; Smith, R.A. Astrophys. J. 190: No. 1, 175-185 (15 May 1974).

We show that the electron streams that give rise to type III solar radio bursts are stable and will not be decelerated while propagating out of the solar corona. The stabilization mechanism depends on the parametric oscillating two-stream instability. Radiation is produced near the fundamental and second harmonic of the local electron plasma frequency. Estimates of the emission at the second harmonic indicate that the wave spectra created by the oscillating two-stream instability can account for the observed intensities of type III bursts. (auth)

25002 A NOTE ON SUMMING SERIES OF BESSEL FUNCTIONS OCCURRING IN CERTAIN PLASMA ASTROPHYSICAL SITUATIONS. Lerche, I. (Enrico Fermi Institute, University of Chicago, Chicago, Illinois). Astrophys. J. 190: No. 1, 165-166 (15 May 1974).

We give the generic method of summing certain series of Bessel functions which occur in plasma astrophysical situations like the solar wind and the Crab Nebula. We believe the closed analytic expression may aid in numerical computations of these sums. It may also enable asymptotic regimes to be investigated analytically in a manner not heretofore available without a closed expression for the Bessel-function sums. (auth)

25003 DENSE SOLAR WIND CLOUD GEOMETRIES DEDUCED FROM COMPARISONS OF RADIO SIGNAL DELAY AND IN SITU PLASMA MEASUREMENTS. Landt, J.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). J. Geophys. Res. 79: No. 19, 2761-2766 (1 July 1974).

The geometries of dense solar wind clouds are estimated by comparing single-location measurements of the solar wind plasma with the average of the electron density obtained by radio signal delay measurements along a radio path between earth and interplanetary spacecraft. Several of these geometries agree with the current theoretical spatial models of flare-induced shock waves. A new class of spatially limited structures that contain regions with densities greater than any observed in the broad clouds is identified. The extent of a cloud was found to be approximately inversely proportional to its density. (auth)

25004 A REVERSE SHOCK ASSOCIATED WITH A STREAM-STREAM INTERACTION: THE FEBRUARY 29, 1968, EVENT. Chao, J.K.; Lepping, R.P. (Laboratory for Extraterrestrial Physics, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771); Binsack, J. J. Geophys. Res. 79: No. 19, 2767-2772 (1 July 1974).

A clearly defined perpendicular fast reverse shock was found in the interplanetary plasma and magnetic field data from Explorer 33 and 35. A Pioneer 8 observation, which is not unambiguously identifiable because of insufficient data, indicates the evolution of this event. It is

suggested that this reverse shock was formed from a stream-stream interaction and that an associated forward shock was developing and probably formed beyond the earth's orbit. (auth)

25005 BOW SHOCK PERTURBATION OF THE UPSTREAM SOLAR WIND PROTON COMPONENT. Feldman, W.C.; Asbridge, J.R.; Bame, S.J. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). J. Geophys. Res. 79: No. 19, 2773-2782 (1 July 1974).

A study of the perturbation of the upstream proton thermal component due to the proximity of the earth's bow shock has been made. When all proton spectra measured by the LASL plasma probe aboard the Imp 6 satellite between March 18, 1971 and May 30, 1972, are sorted according to either a magnetic field–bow shock unconnected or a connected geometry (parallel or antiparallel electron and proton heat flux vectors, respectively), the following results are determined. First, upstream locations on the dawn side of the magnetosphere are connected to the bow shock through the magnetic field B more often than they are on the dusk side, and, for all solar ecliptic longitudes, are connected more often closer to the bow shock. Second, the proton temperature T_p does not depend on whether the plasma is unconnected (U) or connected (C) to bow shock through B, $(T_p)_c = 7.34 \pm 0.21 \times 10^6$°K and $(T_p)_u = 7.56 \pm 0.14 \times 10^6$°K, with ratio $(T_p)_c/(T_p)_u = 0.97 \pm 0.03$. Third, the thermal anisotropy $T/T_\perp$ is less when it is connected to the bow shock, $(T/T_\perp)_c = 1.88 \pm 0.03$ and $(T/T_\perp)_u = 2.00 \pm 0.02$, with ratio $(T/T_\perp)_c/(T/T_\perp)_u = 0.94 \pm 0.02$. Fourth, the dimensionless third velocity moment q_p is also less when it is connected to the bow shock, $(q_p)_c = 0.226 \pm 0.007$ and $(q_p)_u = 0.285 \pm 0.006$, with ratio $(q_p)_c/(q_p)_u = 0.79 \pm 0.04$. These changes are small in comparison with variations of the proton thermal state normally observed in the bow shock unperturbed plasma. These results indicate that the enhanced wave level characteristic of the perturbed plasma is sufficient to scatter yet not transfer measurable amounts of energy to the ambient proton component on time scales less than about 10^3 s. Lastly, the fact that $(q_p)_c < (q_p)_u$ is further evidence that interpenetrating proton streams are not generated by the earth's bow shock. (auth)

25006 THE SOLAR WIND VELOCITY IN THE ELEVEN-YEAR CYCLE NO. 20 AND THE SOLAR RADAR CROSS-SECTION. Pinter, S. (Slovenska Akademia Vied, Hurbanovo (Czechoslovakia). Geofyzikalny Ustav). Solar Phys.; 35: No. 1, 225-232 (Mar 1974).

The annual average values of the solar wind velocity over the period 1962-1972 were investigated on the basis of data obtained from different space probes. The comparison of the pattern of the annual average solar wind velocities observed by the Vela and Pioneer 6 satellites indicates that the pattern presented by Gosling et al. (1971) is realistic. The long-range trend in the solar wind velocity during the 11-year cycle is governed by the number and intensity of irregularities occurring in the corona. These irregularities may represent motions of mass or some types of MHD shock waves and they are responsible for the increased heating of the corona which then in turn causes an increase in the values of the solar radar cross-section and of the solar wind velocity. A close relation is demonstrated between the monthly and annual average values of the solar wind velocity and of the cross-section. (auth)

25007 CENTER-TO-LIMB PROFILES OF THE ALUMINUM AUTOIONIZATION LINES IN THE SOLAR SPECTRUM. McAllister, H. C. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Solar Phys.; 35: No. 1, 3-10(Mar 1974).

The 1929 to 1941 A region of the solar spectrum has been measured, using spectrograms obtained with a rocket-borne high resolution spectrograph. The center-to-limb behavior of the Al I autoionization lines of the $3s^2\ 3p\ ^2P^0 - 3s\ 3p^2\ ^2S$ doublet, at a spatial resolution of approximately three minutes of arc, is reported. The results provide additional data relating to the photospheric–chromospheric transition region. (auth)

25008 COMPUTATION AND OBSERVATION OF ZEEMAN MULTIPLET POLARIZATION IN FRAUNHOFER LINES. II. Computation of Stokes Parameter Profiles. Wittmann, A. (Goettingen Univ. (F. R. Germany)). Solar Phys.; 35: No. 1, 11-29 (Mar 1974).

A self-contained summary of the generalized Unno theory of LTE line formation in solar magnetic fields and its application to the numerical computation of Stokes parameter profiles is given. Within this context, computational details of general interest are described and numerical results for sunspot fields are given. Finally, a new method of computing the height of line formation is presented. (auth)

25009 TEMPERATURE EFFECTS ON MEASUREMENTS OF PHOTOSPHERIC MAGNETIC FIELDS. Caccin, B.; Falciani, R. (Osservatorio Astronomico di Capodimonte, Naples (Italy)); Donati-Falchi, A. (Arcetri Astrophysical Observatory, Florence, Italy). Solar Phys.; 35: No. 1, 31-36(Mar 1974).

The effects of line profile variations, due to the temperature enhancements connected with photospheric magnetographic measurements are evaluated in a quantitative way: taking into account these results, the differences found by many authors between the values of the field obtained with different Fraunhofer lines can be reduced within 10-30%. (auth)

25010 MAGNETIC FINE STRUCTURE AND THE SOLAR MAGNETIC MONOPOLE. Sawyer, C. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA). Environmental Research Labs.). Solar Phys.; 35: No. 1, 37-40(Mar 1974).

Some methods of measuring solar magnetic fields are considered, with the object of gaining further information on the possible monopolar nature of the solar magnetic field near the minimum of solar activity. (NL)

25011 SOME REMARKS ON LINE WEAKENINGS IN PHOTOSPHERIC FACULAE. Caccin, B.; Falciani, R. (Osservatorio Astronomico di Capodimonte, Naples (Italy)); Donati-Falchi, A. (Arcetri Astrophysical Observatory, Florence, Italy). Solar Phys.; 35: No. 1, 41-45(Mar 1974).

A revision of Schmahl's facular model is used for comparisons with the HSRA as average photosphere. On its basis many of the available data, in the visible spectrum, can be explained quantitatively. (auth)

25012 CHROMOSPHERIC ACTIVITY ASSOCIATED WITH MOVING PHOTOSPHERIC MAGNETIC FIELDS. Roy, J. R.; Michalitsanos, A. G. (Hale Observatories, Pasadena, Calif. (USA)). Solar Phys.; 35: No. 1, 47-54(Mar 1974).

With the aid of Hα and Ca II K filtergrams and magnetograms of region McMath 12417 on 3,4 and 5 July 1973, the evolution of a moving rim of positive magnetic flux 50'' long in an area dominated by negative flux has been followed. Chromospheric activity in the form of brightenings and small surges was associated with this moving flux; a concentration of activity is observed at the locations where magnetic fields of opposite sign meet together. The weakening of the Ca II K emission along the edges of colliding opposite fields supports evidence from magnetograms that the photospheric magnetic field at that location has decreased strikingly over a period of six hours. (auth)

25013 HIGH-RESOLUTION PHOTOGRAPHY OF THE SOLAR CHROMOSPHERE. XII. An Attempt to Measure Vertical Velocities of Hα Bright Mottles Beyond the Limb. Loughhead, R. E. (National Standards Lab., Sydney (Australia)). Solar Phys.; 35: No. 1, 55-61(Mar 1974).

Measurements have been made of the heights of seven bright mottles photographed beyond the limb on sequences of broad-band Hα filtergrams. They reveal no evidence of a systematic upward or downward motion persisting throughout the lifetime of a mottle, and in no case does the observed change in height exceed 1'' (725 km) over the period of observation. On the other hand, the possibility cannot be excluded that the bright mottles execute oscillations with velocities comparable to those recently deduced from Hα contrast profile analyses by Grossmann-Doerth and von Uexküll (1971) and Bray (1973) provided the periods do not exceed a few tens of seconds. (auth)

25014 THE GALLOPING CHROMOSPHERE. Sawyer, C. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA). Environmental Research Labs.). Solar Phys.; 35: No. 1, 63-81(Mar 1974).

Oscillating velocity fields can be observed on Hα filtergrams as a shifting pattern of intensity fluctuations known as "the galloping chromosphere". The characteristics of this activity are those of horizontal running waves of typical period (~300 s) and long wavelength (~20000 km) that can be interpreted as acoustic-gravity waves propagating in the acoustic domain. Periods are longer in dark, structured regions, and in fibrils, and the change is quantitatively consistent with the reduction of resonance frequency in a magnetic field of 1 to 10 G. These easily observed fluctuations thus offer a means of estimating magnetic-field strength at specific locations in the chromosphere. Phase velocities are high, ranging upward from typical values between 50 and 100 km s^{-1}, and tending to be lower in active regions, where periods are longer, and toward the limb, where it is speculated that shorter wavelengths are seen at higher levels in the atmosphere. (auth)

25015 A SEARCH FOR 5 MIN PERIODIC STRUCTURE IN SOLAR 2 CM EMISSION. Sentman, D. D.; Shawhan, S. D. (Iowa

Univ., Iowa City (USA). Dept. of Physics and Astronomy). Solar Phys.; 35: No. 1, 83-103(Mar 1974).

Two hundred and eighty-five hours of solar data obtained from the University of Iowa 2 cm radiometer during 1968-1969 were analyzed for evidence of periodic structure related to the 5 min periodic chromospheric oscillations detected in optical line emissions. A power spectral analysis of the data failed to show any statistically significant (>96% confidence) periodic activity in the frequency range 1-15 mHz (periods of 1-16 min) for data organized to solar activity in Hα, soft solar X-rays (2-12 Å), and several microwave frequencies (3-15 GHz). A small shift in power from low to higher frequencies in the power spectrum of the 2 cm data was found to be correlated with Hα and X-ray activity. This power shift is attributed to a relative increase in chromospheric turbulence at altitudes common to Hα, X-ray, and 2 cm emission. Consistent statistical analyses of previous works reported evidence for oscillations at microwave and extreme ultraviolet frequencies indicate that confidence in these previous results is marginal. A model for chromospheric oscillation bursts in quiescent supergranules is incorporated into a statistical analysis of the power spectrum detectability of the oscillations to understand the negative results obtained. (auth)

25016 THE DEPTH OF SUNSPOTS. Prokakis, T. (National Observatory of Athens, Greece). Solar Phys.; 35: No. 1, 105-110(Mar 1974).

Good quality photographs of many regular sunspots were obtained in three spectral regions, with the use of narrow band filters. Isodensity contours were used for measurements of the umbra and penumbra size along different axes of sunspots. A parameter based on the morphology of the whole sunspot was defined for a better study of the Wilson effect. Some interesting results are the following: (a) an east-west asymmetry of the Wilson effect was clearly observed, (b) differences in the phenomenon in the three spectral regions were barely significant compared with observational errors and (c) measurements indicate that larger sunspots have greater depth. (auth)

25017 THE COOLING OF A SUNSPOT. IV. Reply to D. J. Mullan. Wilson, P. R. (Sydney Univ. (Australia). Dept. of Applied Mathematics). Solar Phys.; 35: No. 1, 111-121(Mar 1974).

The recent criticism by Mullan (1973) of sunspot models and the cooling mechanism which has been proposed in Papers I, II and III of this series is considered. The discussion of the cooling produced by an idealized flow cycle has been extended to include vertical temperature gradients which are consistent with a convectively unstable atmosphere. This leads to an expression for Mullan's parameter f (the ratio in which estimates of the energy flux based on an idealized Carnot cycle should be reduced) which is appropriate to this situation. It is shown that, for a cycle similar to that of Paper III, $f = 0.82$, while for one which has a vertical extent of order 5 Mm, $f = 0.4$. Hence the energy flux which, in principle, can be transported away from a sunspot by such a cycle is conservatively estimated to be 1.1×10^{29} erg s^{-1} compared with a typical sunspot energy deficit of 2.2×10^{29} erg s^{-1}. Other criticisms relating to the magnetic field amplification and the "cool one" model are discussed. It is concluded that the essential features of these models remain valid and that the modifications suggested by Mullan's criticism greatly increase their applicability to the sunspot problem. (auth)

25018 THE FORMATION OF SOLAR QUIESCENT PROMINENCES BY CONDENSATION. Hildner, E. (High Altitude Observatory, Boulder, Colo. (USA)). Solar Phys.; 35: No. 1, 123-136(Mar 1974).

The formation of solar quiescent prominences is modelled by solving numerically the nonlinear, time-dependent, magnetohydrodynamic equations governing the condensation of the corona. A two-dimensional geometry is used. Gravitational and magnetic fields are included, but thermal conduction is neglected. The coronal fluid is assumed to cool by radiation and to be heated by the dissipation of mechanical energy carried by shock waves. A small, isobaric perturbation of the initial thermal and mechanical equilibrium is introduced and the fluid is allowed to relax. Because the corona with the given energy sources is thermally unstable, cooling and condensation result. When magnetic and gravitational fields are absent, condensation occurs isotropically with a strongly time-dependent growth rate, and achieves a density 18 times the initial density in 3.5×10^4 s. The rapidity of condensation is limited by hydrodynamical considerations, in contrast to the treatment of Raju (1968). When both magnetic and gravitational fields are included, the rate of condensation is inhibited and denser material falls. It is concluded that: (1) condensation of coronal material due to thermal instability is possible if thermal conduction is inhibited; (2) hydrodynamical processes determine, in large part, the rate of condensation; (3) condensation can occur on a time scale compatible with the observed times of formation of quiescent prominences. (auth)

25019 THE QUIET CORONA: TEMPERATURE AND TEMPERATURE GRADIENT. Bame, S. J.; Asbridge, J. R.; Feldman, W. C. (Los Alamos Scientific Lab., N. Mex. (USA)); Kearney, P. D. (Colorado State Univ., Fort Collins (USA). Dept. of Physics). Solar Phys.; 35: No. 1, 137-152(Mar 1974).

A study of the lower corona thermal properties was made using examples of solar wind heavy ion spectra obtained with Vela 5 and 6 plasma analyzers at times of quiet solar wind (low speed, low temperature). The multiple Si and Fe ion species peaks in the spectra were fitted with solutions of the ionization equilibrium equations to determine "freezing in" temperatures for the various species over a range of heliocentric distances r. Assuming a power law electron temperature model, $T = T_\odot (R_\odot/r)^\alpha$, spherical symmetry, and mass conservation, the following results for the quiet corona were obtained: (1) The average freezing in temperatures ranged near 1.5×10^6 K at $r \simeq 2.4$ to 3.9 $R_\odot$. (2) Values for $T_\odot$ ranged between 1.7×10^6 K and 2.5×10^6 K with an average of $1.84 \pm 0.13 \times 10^6$ K. (3) The temperature gradient parameter α lay between 0.20 and 0.41 with an average value of 0.29 ± 0.06. This is consistent with the predicted value $\alpha = 2/7$ derived from conduction dominated spherically symmetric models of the corona. (4) The O and N lines which freeze in at a distance of $r \simeq 1.5\ R_\odot$ indicate temperatures of $\sim 2.1 \times 10^6$ K. Temperatures higher at 1.5 $R_\odot$ than at 3 $R_\odot$, in agreement with extrapolations of the power law model, suggest that coronal heating in regions of open field geometry is not important beyond $r \simeq 1.5\ R_\odot$. (auth)

25020 ON THE OBSERVATION OF SCATTERED RADIO EMISSION FROM SOURCES IN THE SOLAR CORONA. Riddle, A. C. (Commonwealth Scientific and Industrial Research Organization, Epping (Australia). Div. of Radiophysics). Solar Phys.; 35: No. 1, 153-169(Mar 1974).

The effects of scattering and refraction on radio waves in the solar corona are considered for several different coronal models. By considering a source near the plasma level in a spherically symmetric corona and in a streamer enhancement superimposed on a spherically symmetric corona results relating to bursts of types I, II and III are obtained. From the results of these calculations it is suggested that estimates of coronal density derived from observations of type II and type III bursts are too high by a factor of 1.5 to 2; that there is considerable doubt about the accuracy of coronal temperatures estimated from rate of decay of type III bursts; and that the duration of, and velocity dispersion in, the exciters of type III bursts have probably been over-estimated. The effects of scattering and refraction are also considered as they relate to observations and interpretations of harmonic source radiation patterns, drift pair bursts and spike bursts. (auth)

25021 THE CORONAL DISTURBANCE OF AUGUST 12, 1972. Riddle, A. C. (Colorado Univ., Boulder (USA)); Tandberg-Hanssen, E.; Hansen, R. T. (High Altitude Observatory, Boulder, Colo. (USA)). Solar Phys.; 35: No. 1, 171-179(Mar 1974).

The association of flare sprays, distortions of the overlying coronal structures and moving type IV radio bursts is a reasonable one and is well accepted despite the paucity of observational evidence. On 1972, August 12, there occurred a flare spray observed optically by both flare patrol and coronagraph instruments. A subsequent moving type IV radio burst was recorded by several instruments and distinct changes in the coronal brightness at 1.6 $R_\odot$ were measured. These observations combine to form one of the most complete sequences of measurements yet recorded covering the range from the chromosphere to about 6 $R_\odot$. The separate measurements are discussed and it is shown that they can be combined to form a relatively simple physical picture of the whole event. (auth)

25022 CORONAL MAGNETIC FIELD STRUCTURE DERIVED FROM TWO-FREQUENCY RADIOHELIOGRAPH OBSERVATIONS. Kai, K.; Sheridan, K. V. (Commonwealth Scientific and Industrial Research Organization, Epping (Australia). Div. of Radiophysics). Solar Phys.; 35: No. 1, 181-192(Mar 1974).

An exceptional variety of positions and polarizations was found for two type I storms and numerous sporadic bursts observed during 15 consecutive days with the Culgoora radioheliograph at 80 and 160 MHz. The radio data are combined with optical data to derive a model of the coronal magnetic field structure for a complex of active regions; in this model the type I sources are located on multiple strong-field loops, and the sources of the sporadic bursts on widely diverging weak-field arches. It is also shown that this model can explain the seemingly erratic placement of the storm sources and the appearance of the sporadic

sources round a large arc. The observed positions and polarizations support, rather convincingly, the hypothesis that type I and type III radiations are of the ordinary magnetoionic mode. (auth)

25023 OBSERVATIONS OF SOLAR X-RAY BURSTS IN THE ENERGY RANGE 5 TO 15 keV. Datlowe, D. W.; Hudson, H. S.; Peterson, L. E. (California Univ., La Jolla, San Diego (USA)). Solar Phys.; 35: No. 1, 193-206(Mar 1974).

Bursts of solar X-rays in the energy range 5-15 keV are associated with flares and are due to thermal emission from a hot coronal plasma. The results of the first study of a large sample of separate bursts, 197 events associated with subflares and a few importance 1 events, are presented. The observations were made by a proportional counter on the satellite OSO-7 from October 1971 to June 1972. In most cases the temperature characterizing the X-ray spectrum rises impulsively at the onset of the burst and then declines slowly throughout the remainder of the burst. The emission measure rises exponentially with a time scale of 30-100s and then declines slowly, on a time scale of the order of 10^3 s. From these observations it is shown that the growth of the thermal energy in the flare plasma throughout the burst can be due to the heating of new cool material. (auth)

25024 ON THE ROLE OF THE MAGNETIC CONFIGURATION OF FLARES FOR PRODUCTION OF TYPE III SOLAR RADIO BURSTS. Axisa, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service d'Electronique Physique). Solar Phys.; 35: No. 1, 207-224(Mar 1974).

The possibility that the particular location of flare production sites in an active region is intimately connected to the production of type III radio bursts as well as centimetric and hard X-ray events is investigated. For the few active regions analyzed (viz. McMath 8863, 8905, 8907 and 8921) it is shown that even a crude statistical test is sufficient in revealing significant differences concerning the emissions of these radiations by flares located in various flare production sites. In particular, flares located outside the general dipolar pattern of the active region are characterized by a higher type III flare association rate (≥ 50%) than those taking place inside of it (≤ 20%). Centimetric and hard X-ray events are more likely to be expected in connection with flares located inside strong magnetic fields arising from well developed sunspots. Such results are pointing out that the concept of "flare production sites" is important not only in relation with the Hα flare activity but also in relation with the non-thermal emissions accompanying the flares. Probably this is due to changing magnetic configuration from one flare site to the other. (auth)

25025 AUTOCORRELATION ANALYSIS OF THE SOLAR WIND FLOW SPEED MEASURED WITH THE ESRO-HEOS-1 SATELLITE (DECEMBER 1968–FEBRUARY 1970). Borghesi, A.; Leggieri, G.; Pizzella, G. Riv. Ital. Geofis.; 22: 141-143(1973).

25026 STUDY OF X-RAY FLARE IN RELATION TO CORRESPONDING SUDDEN PHASE ANOMALY. Sain, M. (All India Radio, Jaipur); Rao, U. K. J. Inst. Telecommun. Eng.; 16: No. 11, 820-826(Nov 1970).

An exhaustive study of X-ray flare which occurred on 13 April 1966 between 0706 and 0716 UT has been made in relation to the corresponding phase changes observed on three transmission circuits recorded at Inubo (Japan) on NPG (18.6 kc/s), NSS (21.4 kc/s) and GBZ (19.6 kc/s). From these studies the value of Nr/No comes to 0.75 where Nr is the electron density at the height of reflection and No is the maximum electron density. The height of maximum electron production has been found to be 65 km and the height of reflection at the subsolar point as 58.5 km. Assuming the Chapman layer produced below the D-layer (Chilton et al., 1963), the value of X-ray wavelength responsible for this SPA has been found to be 1.8 Å and corresponding flux energy as 1.02×10^{-4} erg cm^{-2} sec^{-1}. The observed value of flux energy as found at the maximum of X-ray flare on 13 April 1966 comes to 2.1×10^{-4} erg cm^{-2} sec^{-1} which is in good agreement with the value calculated from the analysis of corresponding SPA. These results show that X-ray flux intensities may be computed reasonably well from the ground based observations of SPA on different paths. (auth)

25027 SPECTRUM OF 11-YEAR COSMIC-RAY VARIATIONS IN THE HIGH-ENERGY REGION AND THE LARGE-SCALE STRUCTURE OF THE SOLAR WIND. Bishara, A. A.; Dorman, L. I. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 664-668(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 782-787(1973).

Four different forms of the primary spectrum of δD/D are tested on the basis of surface and underground observations of 11-year variations of the meson component of cosmic rays. It is demonstrated that the best agreement with experiment in the high energy region is obtained for a power-law spectrum with an exponent $\gamma = 0.77 \pm 0.07$ and cutoff on the side of high energies at $R_{max} = 265^{+35}_{-25}$ GV. To explain the result obtained, it is assumed that the largest scale of inhomogeneities is determined by the transverse dimensions of interplanetary magnetic-field sectors. In this case, the effective dimensions of the modulating region of the solar wind decrease with an increase in the rigidity of recorded particles, R, because of the decreasing field intensity in the sectors with distance from the sun. (auth)

Galaxies

Refer also to abstracts 24960, 24971, 24982, and 25069.

25028 (AD-740985) LOW DISPERSION SPECTRA OF GALAXIES. I. The Coma and Virgo Clusters. Final Report. Philip, A. G. D.; Sanduleak, N. (Dudley Observatory, Albany, N. Y. (USA); State Univ. of New York, Albany (USA)). 5 Sep 1969. Contract N00014-67-C-0348. 21p. NTIS $3.00.

Low-dispersion objective-prism spectra (approximately 10,000 A/mm) were obtained of galaxies in the Coma and Virgo Clusters. Composite color indices were derived from the spectra, which when combined with magnitudes obtained from the Catalogue of Galaxies and of Clusters of Galaxies (Zwicky et al.) allowed color magnitude diagrams for the clusters to be drawn. The differences between the diagrams for different clusters indicate that the method will prove useful in the study of the color distribution within clusters of galaxies, as well as in the identification of the bluest and reddest galaxies which might warrant further study at a higher dispersion. (auth)

25029 (AD-740986) LOW DISPERSION SPECTRA OF GALAXIES. II. Hercules and Abell No. 2197-2199. Final Report. Philip, A. G. D. (Dudley Observatory, Albany, N. Y. (USA); State Univ. of New York, Albany (USA)). 5 Sep 1969. Contract N00014-67-C-0348. 15p. NTIS $3.00.

Low-dispersion spectra (approximately 10,000 A/mm) were obtained of the brighter members of the Hercules Cluster and Abell no. 2197 and 2199. The survey identifies the reddest and bluest galaxies in each cluster. Color-magnitude diagrams are drawn for each cluster. (auth)

25030 (AD-776042/4) OBSERVATIONS OF GALACTIC CARBON MONOXIDE EMISSION AT 2.6 MILLIMETERS. Report for January 1972–October 1973. Wilson, W. J.; Schwartz, P. R.; Epstein, E. E.; Johnson, W. A.; Etcheverry, R. D. (Aerospace Corp., El Segundo, Calif. (USA)). 25 Feb 1974. Contract F04701-73-C-0074. 42p. (SAMSO-TR-74-42). NTIS $3.25.

A wide variety of galactic sources have been observed at 2.6 mm (115271.2 MHz) to determine the extent and strength of interstellar $^{12}C^{16}O$. Extended regions of CO emission were found in the direction of 32 HII regions and five supernova remnants. The CO emission was found to be larger in spatial extent than the 6-cm continuum HII emission, and CO emission maxima appear to be related to continuum emission peaks and infrared sources in several sources. Except near optically dark nebulas, little CO emission was detected away from the galactic plane. Radial velocities of the CO emission are within 10 km/s of the OH, HII (109 alpha), and H_2CO velocities measured by other observers for the same sources. $^{13}C^{16}O$ was also measured in many of the stronger sources. The optical depths calculated for $^{12}C^{16}O$ range between 20 and 120, assuming the terrestrial value of $1/_{89}$ for the ratio of $^{13}C/^{12}C$. For excitation temperatures in the range 10 to 50 K. The calculated projected densities range from 10^{15} to 2.5×10^{19} molecules/sq cm. (auth)

25031 RADIO EMISSION FROM PROTOCLUSTERS OF GALAXIES. Novokreshchenova, S.I.; Rudnitskii, G.M. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 50: No. 4, 553-554 (Jan 1974).

Observable manifestations of protoclusters of galaxies are discussed in terms of the theory of adiabatic density fluctuations. The relatively cool ($T \simeq 10^4$ °K) inner layer of protocluster should be observable in the 21-cm line. Radio emission from the ionized outer layers in the continuum and in the recombination lines would be too weak to be detectable with present techniques. Absorption in the intergalactic medium and in galaxy clusters will be small and should not impede the observations. (auth)

25032 FLUCTUATIONS OF DENSITY AND VELOCITY IN YOUNG ORION-TYPE NEBULAE. Pikel'ner, S.B.; Sorochenko, R.L. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 17: No. 4, 443-448 (Jan 1974).

The density of the Orion Nebula estimated from the ratio of the [O II] components and from the excited-hydrogen radio lines conflicts with estimates from the radio brightness, especially in the central region,

where the brightness is strongly enhanced. This circumstance is interpreted as evidence of a nonuniform gas distribution. The orgin of such condensations is discussed. Stellar wind from the O star is decelerated, producing a rarefied high–temperature gas. The high pressure of this gas generates a shock wave in the form of a thin dense shell moving at 50–70 km/sec. Density irregularities ahead of the shock will distort this shell; a typical deformation is calculated. As the shell passes an orginal density fluctuation will be compressed, and behind it a radially oriented filament will form, gradually be stretched out, and ultimately disappear. The density of all condensations is governed by the pressure of the high–temperature gas, and is $\simeq 10^4$ cm^{-3}. The [O II] component ratio calculated from this model agrees well with the observations. The condensations maintain part of the shock velocity. Splitting of some lines is observed in condensations where compression is still occurring. (auth)

25033 VORTEX OF STARS NEAR THE SOLAR APEX. Radzievskii, V.V.; Medvedeva, E.V. (Lenin Teachers' College, Moscow). Sov. Astron.–AJ 17: No. 4, 476-481 (Jan 1974).

It is established that the stars of all spectral types within the field bounded by galactic coordinates $l = 55° \pm 20°$, $b = 0° \pm 15°$, and whose distance according to the optimum indicator is 100–300 pc, form a system rotating about the center of the field: 96 of 130 stars exhibit retrograde motion with a mean space velocity of $\simeq$20–30 km/sec. As shown in a previous paper, the great majority (32 of 36) of the visual binary stars in approximately the same region also have components with retrograde motion. A method is described for determining the mean vortex component μ^C of the proper motion of the stars without eliminating from μ the effects of galactic rotation and solar motion toward the apex. It is shown how one can decide (in terms of the two–body problem) wheather the sun is a dynamical member of the vortex, independently of its mass and distance r_C (one uses the angular size of the vortex and the ratio $\mu^C/\mu^\odot$, where $\mu^\odot$, the solar–motion component of μ, is also determined independently). The sun's energy relative to the vortex is found to be negative; the eccentricity e of its orbits is 0.95, and its true anomaly $\varphi = 218°$. The next passage of the sun through pericenter will occur in just 2.2% of the total revolution period. The other dynamical parameters of the vortex depend on the distance of its center from the sun; they are tabulated for two limiting values of r_C, 100 and 300 pc. Perhaps the high density of matter in the central region of the vortex ($\simeq 10^{-21}$ g/cm^3), where the pericenter of the sun's orbit is located and through which the sun passes about once every 10^8 yr, may have had a substantial influence on the evolution of the solar system and the geological history of the earth. (auth)

25034 SPECIFICATION OF THE APPARENT FLATTENING OF SPIRAL GALAXIES. Vorontsov–Vel'yaminov, B.A. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 17: No. 4, 452-456 (Jan 1974).

Before performing various reductions to establish the true flattening of a galaxy, one must properly specify its apparent flattening R=a/b. Holmberg's widely used corrections of visual determinations of R are much exaggerated in comparison with other microphotometer measurements. A large subjective judgement is inherent in determining the placement and flattening of isophotes close to the plate limit, and even in the best series of measurements R is determined to low accuracy. The scale of flattening for galaxies in the Morphological Catalog brighter than 13^m is closer to the scale established microphotometrically than for galaxies in other catalogs. However, it is inappropriate to accept unconditionally the flattening of an arbitrary isophote, even if it is flawless, because spiral galaxies comprise three subsystems: a nuclear region (often complex), a flat component, and an extended component that approaches sphericity at its boundary. In each the flattening of the isophotes is a function of the major axis. The flattening of the outermost isophote is not representative of the oblateness of the ellipsoid that should be taken to approximate the mass distribution of a flat galaxy in dynamical investigations. (auth)

25035 DUST IN THE CENTRAL REGIONS OF NORMAL GALAXIES. Pronik, I.I. (Crimean Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 4, 457-459 (Jan 1974).

An upper limit on the amount of dust in the central regions of 81 normal galaxies has been estimated from Tifft's photoelectric observations[11-13] and Morgan's galaxy classification[14]. The highest value, $10^5\ M_\odot$, is obtained for the central region of NGC 4088. (auth)

25036 DUST GRAINS IN A HOT GAS. I. BASIC PHYSICS. Burke, J.R. (Department of Physics, San Francisco State University); Silk, J. Astrophys. J. 190: No. 1, 1-10 (15 May 1974).

The interaction of graphite grains with a hot gas is investigated. Detailed computations, based on experimental data and simple theoretical models, are presented of the energy transfer by gas particle collisions and of the sputtering rates and grain lifetimes, as functions of gas temperature and grain radius. The electric charge on the grains is calculated, and the effect of electric forces on mechanical stability is discussed. The rate at which the gas cools by this mechanism is evaluated. (auth)

25037 DUST GRAINS IN A HOT GAS. II. ASTROPHYSICAL APPLICATIONS. Silk, J. (Department of Astronomy, University of California, Berkeley); Burke, J.R. Astrophys. J. 190: No. 1, 11-17 (15 May 1974).

The results of the work of Burke and Silk on gas–grain cooling and sputtering rates are applied to various astrophysical environments where dust and hot gas may coexist. The effect is studied of swept–up interstellar grains on the evolution of young supernova remnants, and the infrared luminosity is computed as a function of the age of the remnant. We propose an interpretation of far–infrared sources embedded in compact H II regions or dense clouds, in terms of the supernova phneomenon, with specific application to η Carinae. We also reexamine the question of the existence of dust in intergalactic matter in galaxy clusters. (auth)

25038 ON THE STELLAR CONTENT AND REDDENING IN THE NUCLEUS OF NGC 5195. Warner, J.W. (Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, D.C. 20015). Astrophys. J. 190: No. 1, 19-26 (15 May 1974).

Spectrophotometric observations of the nucleus of NGC 5195 were made using photographic methods. Absorption–line equivalent widths and continuum measures were compared with models of the stellar content composed of 11 stellar groups. Significant differences were noted for the calcium, magnesium, and sodium lines implying possible overabundances in these elements and interstellar contributions to the calcium and sodium lines. All models were found to be bluer than the observed continuum suggesting that some interstellar absorption is present in front of or in the nucleus. The [N II]/Hα ratio is estimated for two regions centered on the nucleus and is found to be greater than unity. Similarities and differences with M82 are noted. (auth)

25039 THE GRAVITATIONAL SLINGSHOT AND THE STRUCTURE OF EXTRAGALACTIC RADIO SOURCES. Saslaw, W.C. (Institute of Astronomy, University of Cambridge); Valtonen, M.J.; Aarseth, S.J. Astrophys. J. 190: No. 2, 253-270 (1 June 1974).

We propose a simple dynamical mechanism to eject massive objects from the nuclei of galaxies. When three or more massive objects near the center interact strongly, the configuration becomes gravitationally unstable and splits up. In the case of three objects, two of them will usually form a compact binary and fling out the third. The recoil momentum can eject the binary from the galaxy in the opposite direction. To study the interaction for a large range of initial conditions, we have numerically computed the orbits of 25,000 triple systems and of 250 two–binary systems. Their general properties are analyzed and compared with the observed structures of extragalactic radio sources. The double nature of many radio sources, their association with the plane of a central elliptical galaxy, the presence of very compact radio components, and a number of other observed properties are readily related to the gravitational slingshot. We also discuss observational constraints on radio emission from the massive objects, and further observations of special interest. (auth)

25040 MONTE CARLO MODEL OF REFLECTION NEBULAE: INTENSITY GRADIENTS. Roark, T.; Roark, B.; Collins II, G.W. (Perkins Observatory, The Ohio State and Ohio Wesleyan Universities). Astrophys. J. 190: No. 1, 67-72 (15 May 1974).

Theoretical photometric surface–intensity gradients are computed for three–dimensional model reflection nebula. A nonbiased Monte Carlo analog to the multiple–scattering problem is used. Comparison of our results with those obtained by earlier, semianalytic approaches indicate the latter do not adequately take account of multiple scattering within such model nebulae. Observed intensity gradients are briefly discussed with respect to theoretical interpretations. (auth)

25041 THE MASS OF M31 AS DETERMINED FROM THE MOTIONS OF ITS GLOBULAR CLUSTERS. Hartwick, F.D.A. (University of Victoria); Sargent, W.L.W. Astrophys. J. 190: No. 2, 283-284 (1 June 1974).

An application of the virial theorem to van den Bergh's velocity measurements for the globular clusters results in a mass for M31 which is consistent with that derived by Rubin and Ford from the rotation curve. It is shown that there is a correlation between the clusters' velocity dispersion and their metallicity in the sense that metal–poor clusters have a larger velocity dispersion than metal–rich ones. (auth)

25042 ON THE TIDAL ORIGIN OF THE BRIDGE OF ARP 295. Stockton, A. (Institute for Astronomy, University of Hawaii). Astrophys. J. Lett. 190: No. 2, L47-L49 (1 June 1974).

Rotation curves are presented for the two principal galaxies of the interacting system Arp 295. The relative radial velocities and the ratio of masses of the two components are in good agreement with the tidal model for the system proposed by Toomre and Toomre. (auth)

25043 ON MICROWAVE RECOMBINATION LINES FROM HI REGIONS. Zuckerman, B. (University of Maryland, College Park, Maryland 20740 and University of California, Berkeley, California 94720); Ball, J.A. Astrophys. J. 190: No. 1, 35-51 (15 May 1974).

We observed recombination lines attributed to carbon at 21–, 30–, 36–, and 43–cm wavelengths towards IC 1795 (W3), Orion A, and NGC 2024; and a narrow hydrogen line toward NGC 2024. A comparison of a considerable body of carbon recombination–line and radio molecular–line data indicates that these two types of lines are probably formed in dense contiguous regions—the carbon lines in a thin layer facing a hot star and the molecular lines in the rest of the cloud shielded from the stellar radiation by the carbon–emitting slab. This slab should be approximately the same as that responsible for much of the far–infrared flux that emerges from the vicinity of H II regions. The high–frequency carbon lines toward Orion A are probably due to spontaneous rather than stimulated emission, which might not play an important role in any carbon-line emission region. In NGC 2024 the HI regions responsible for the observed hydrogen and carbon lines are probably dense ($n_H > 10^3$ cm^{-3}). Previous estimates of the fractional ionization of hydrogen may be inaccurate because different volumes of gas may be observed in the hydrogen and carbon recombination lines. Without further calculations and observations it is not possible to decide whether the narrow hydrogen line originates in a dense "cloud" or in an ionization front. (auth)

25044 A REDETERMINATION OF THE GALACTIC HI HALF–THICKNESS AND A DISCUSSION OF SOME DYNAMICAL CONSEQUENCES. Jackson, P.D. (Astronomy Program, University of Maryland, College Park); Kellman, S.A. Astrophys. J. 190: No. 1, 53-58 (15 May 1974).

We have redetermined the half–thickness, $z_{1/2}$, of the neutral hydrogen layer of our Galaxy over a significant portion of the disk (1.4 kpc $\leq R \leq$ 16.8 kpc). Four high–resolution 21–cm surveys were employed, and corrections were made for the effects of finite optical depth in the 21–cm line. We find that $z_{1/2}$ is approximately constant for 4.5 kpc $\leq R \leq$ 10 kpc and averages 260 pc for $0° \leq l \leq 90°$ and 230 pc for $270° \leq l \leq 360°$. Outside this range of R, $z_{1/2}$ decreases to about 100 pc when $R < 4$ kpc and increases rapidly with R for $R > 12.5$ kpc, except in the region $160° \geq l \geq 110°$. Using this thickness in conjunction with a recent galactic mass model, we are able to determine the quantity Q over a large portion of the galactic disk, where Q^2 is the ratio at the galactic plane of the sum of the gas, magnetic, and cosmic–ray pressures to the gas density. We find that for $R < 10$ kpc, both $z_{1/2}$ and Q show local maxima in regions occupied by spiral arms of neutral hydrogen and by giant H II regions. For $R > 10$ kpc, only Q may exhibit a correlation with spiral features. The ambient values of Q are generally near 10 km s^{-1} over a large portion of the galactic disk from 3 kpc $\leq R \leq$ 15 kpc. (auth)

25045 INFRARED EMISSION BY DUST IN NGC 1068 AND THREE PLANETARY NEBULAE. Jameson, R.F.; Longmore, A.J.; McLinn, J.A.; Woolf, N.J. (University of Minnesota). Astrophys. J. 190: No. 2, 353-357 (1 June 1974).

Photometric observations of NGC 1068, NGC 7027, IC 418, and BD+30°3639 between 5 and 27 μ are reported. The observations are explained as thermal radiation from a form of dust that shows spectral features, but which has not yet been identified, and resembles that in the carbon–rich RV Tauri star AC Her. Arguments are deduced for its being a condensate from a carbon– and nitrogen–rich gas in an excited environment. (auth)

25046 THE MAGELLANIC STREAM. Mathewson, D.S.; Cleary, M.N. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University); Murray, J.D. Astrophys. J. 190: No. 2, 291-296 (1 June 1974).

A southern sky survey of H I in the velocity range -340 to +380 km s^{-1} has shown that a long filament of H I extends from the region between the Magellanic Clouds down to the south galactic pole and connects with the long H I filament discovered recently by Wannier and Wrixon and van Kuilenburg. There is also some evidence that this continues on the other side of the Magellanic Clouds and crosses the galactic plane at $l^{II} = 306°$. This filament, which follows very closely a great circle over its entire 180° arc across the sky, is given the name "the Magellanic Stream." It may have been produced by gravitational interaction between the Small Magellanic Cloud and the Galaxy during a close passage (20 kpc) of the SMC some 5×10^8 years ago, although it is impossible to account for the observed radial velocities along the Stream unless some force other than gravity is invoked to act on the Stream as well. There are also reasons for doubting whether the Magellanic Clouds have ever come closer than about 40 kpc from the galactic center. These arise from the smooth manner in which the radial–velocity contours of the inter–Cloud region connect with the radial-velocity contours of H I in the main bodies of the Large and Small Magellanic Clouds and from the continuity of the general velocity gradient across the whole Magellanic System which indicate that a bridge of gas exists between the two galaxies and that they form a bound system. This implies that the Clouds did not make a close approach (20 kpc) to the galactic center. If this is correct, some other explanation must be sought to explain the Magellanic Stream (and the warp of the galactic plane). Maybe the H I in the inter-Cloud region foetal gas remaining after the formation of the LMC and SMC, and perhaps collisions with the intergalactic wind or explosions may have expelled gas from this region to form the Magellanic Stream. (auth)

25047 OBSERVATION OF ENHANCED SOFT X-RAY EMISSION FROM THE VICINITY OF THE NORTH POLAR SPUR. de Korte, P.A.J.; Bleeker, J.A.M.; Deerenberg, A.J.M. (Cosmic Ray Working Group, Royal Dutch Academy of Sciences, Kamerlingh Onnes Laboratory, Leiden, The Netherlands); Tanaka, Y.; Yamashita, K. Astrophys. J. Lett. 190: No. 1, L5-L8 (15 May 1974).

Enhanced soft X–ray emission from the vicinity of the North Polar Spur has been found by rocket–borne soft– X–ray detectors in the energy range 0.15–1.2 keV. The location of the regions of enhanced emission and the observed photon fluxes are in fair agreement with a recent experiment of Bunner et al. which had up to now not been confirmed. (auth)

25048 CHLORINE–BEARING MOLECULES IN INTERSTELLAR CLOUDS. Jura, M. (Princeton University Observatory). Astrophys. J. Lett. 190: No. 1, L33-L34 (15 May 1974).

The reaction $Cl^+ + H_2 \rightarrow HCl^+ + H$ is rapid, and it leads to the formation of the molecules HCl^+, H_2Cl^+, and HCl. It may be possible to detect HCl^+ near 3600 Å, and HCl may be observable at 1291 Å. Also, photodissociation of HCl^+ may be a significant source of protons within clouds, and chemical heating resulting from the destruction of chlorine–bearing molecules may account for perhaps 1–10 percent of the expected cooling from diffuse interstellar clouds. (auth)

25049 HARTREE–FOCK BOUND STATES FOR MOLECULE–IONS HeC^{2+} AND HeC^+. Harrison, S.W. (Borough of Manhattan Community College, New York, N. Y. 10020); Henderson, G.A.; Massa, L.J.; Solomon, P. Astrophys. J. 189: No. 3, 605-607 (1 May 1974).

Roothaan–Hartree–Fock calculations on the molecule–ions HeC^{2+} and HeC^+ suggest that they are stable, but weakly bound, systems. Spectroscopic constants for the $^1\Sigma^+$ ground state of HeC^{2+} and the presumed $^2\Pi$ ground state of HeC^+ are given. It is suggested that these molecule–ions may exist in interstellar space. (auth)

25050 THE POLARIZATION OF NORMAL GALAXIES AT RADIO WAVELENGTHS. Wardle, J.F.C.; Sramek, R.A. (National Radio Astronomy Observatory, Green Bank, West Virginia). Astrophys. J. 189: No. 3, 399-404 (1 May 1974).

The integrated linear polarization of 13 elliptical and four spiral galaxies has been measured at 2695 and 8085 MHz. The spiral galaxies are all weakly polarized. Among the elliptical galaxies, those with compact "active" radio sources are weakly polarized, while those with extended "passive" radio sources tend to be quite strongly polarized. There may also be a tendency for the less–flattened systems to be "passive" systems, and for the "passive" systems to have their magnetic field aligned along either the major or minor axis. The observed depolarization of NGC 6047 implies a density of interstellar ionized hydrogen of about 2×10^{-4} cm^{-3}. (auth)

25051 LINE SPECTRA IN INTERSTELLAR CLOUDS. I. THE PERSEUS 2 CLOUD. Chaffee, F.H. Jr. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory, Cambridge, Massachusetts 02138). Astrophys. J. 189: No. 3, 427-440 (1 May 1974).

An observational study of interstellar lines in the spectra of ξ Per, ζ Per, and o Per in the region 3100 Å $\leq \lambda \leq$ 4300 Å is presented. The fact that a single interstellar cloud lies along the line of sight to two of these stars considerably simplifies the analysis of the interstellar features. Spectral lines arising from Ca II, Na I, Ti II, Fe I, CN, CH, and CH^+ have been detected and studied by means of a Cassegrain echelle spectrograph. From several arguments a diameter of 16 pc and a mean hydrogen density of 30 cm^{-3} can be assigned to the cloud. An ionization model of the cloud has been constructed based on White's measured electron densities. The inferred abundances of the atomic constituents suggest that calcium, titanium, and iron are underabundant by an average of 1200, 800, and 5, respectively; sodium is found to be nearly solar. It is suggested that the observed depletions reflect a condensation sequence in a cooling solar nebula and represent abundances characteristic of the general interstellar medium. The observed molecular column densities seem inconsistent with the predictions of Solomon and Klemperer, and this suggests that physical processes other than the simple gas–phase reactions considered by these authors may be responsible for determining interstellar diatomic molecular equilibria. For both atomic and molecular constituents, the Perseus 2 cloud is found to be rather heterogeneous—variations up to factors of 10 in some trace–element abundances exist from point to point in the cloud. (auth)

25052 MOLECULAR CLOUDS. Goldreich, P.; Kwan, J. (California Institute of Technology, Pasadena). Astrophys. J. 189: No. 3, 441-453 (1 May 1974).

It is proposed that molecular clouds are in a state of gravitational collapse. The coupled equations of statistical equilibrium and radiative transfer from diatomic molecules in a collapsing cloud are solved for arbitrary optical depths in the rotational lines. It is shown that most of the observed CS and SiO lines and the stronger CO lines are optically thick. In this limit the emitted intensities are independent of the molecular dipole moments. The rate at which energy is radiated in the CO lines is found to exceed the rate at which work is done by the adiabatic compression of the collapsing gas. This result implies the existence of an energy source which maintains the temperature of the gas against the cooling due to radiative energy losses. It is suggested that collisions between gas molecules and warm dust grains transfer energy to the gas. The dust grains are heated by radiation from H II regions and protostars in the center of the molecular cloud. This picture is supported by the detection of copious far infrared fluxes from many molecular clouds. The rate of energy transfer from the dust to the gas is calculated to be sufficient to maintain the gas at temperatures deduced from observations of CO lines if $N_{H2} > 10^4$ cm^{-3}. (auth)

25053 OH OBSERVATIONS NEAR THE REFLECTION NEBULAE NGC 2068 AND NGC 2071. Johansson, L.E.B.; Höglund, B. (Onsala Space Observatory, S-430 34 Onsala, Sweden); Winnberg, A.; Nguyen-Q-Rieu; Goss, W.M. Astrophys. J. 189: No. 3, 455-458 (1 May 1974).

Narrow OH emission lines at 1667 MHz, apparently from a class I source, have been observed near the reflection nebula NGC 2071. The region contains many T Tauri stars. OH emission corresponding to the dust cloud north and east of NGC 2024 is also seen. At 1720 MHz, the dust-cloud component appears in absorption; presumably the isotropic 2.7°K cosmic background is being absorbed. (auth)

25054 ON THE USE OF MEAN ESCAPE PROBABILITIES TO SOLVE TRANSFER PROBLEMS IN NEBULAE. Bernat, A.P.; Robbins, R.R. (University of Texas at Austin). Astrophys. J. 189: No. 3, 459-462 (1 May 1974).

Results from an accurate numerical solution are compared with the solutions predicted by one particular formulation of mean escape probabilities. It is found that the latter do not predict numerical solutions well and that it is difficult to determine a priori how to improve the agreement. Solution of transfer problems by mean escape probabilities seems consistently to underestimate the optical depth in a transfer problem and hence the density. Mean escape probabilities can be extremely useful, however, in solving additional "nearby" cases when one solution is known to high accuracy; in sample calculations by the authors, problems previously requiring 4 hours on the computer were solved in 45 seconds, a factor of approximately 300 in computer time! (auth)

25055 A GALACTIC MODEL WITH A PULSATING ACTIVE NUCLEUS. II. Chemical Evolution. Ohnishi, T. (Kyoto Univ., Uji (Japan). Inst. of Atomic Energy). Astrophys. Space Sci.; 28: No. 2, 325-350(Jun 1974).

The chemical evolution of the Galaxy with a pulsating active nucleus is investigated. The surface densities of gas, stellar remnants, stars and chemical species such as helium and heavy elements in $Z \geqq 6$ are calculated as functions of the position in the Galaxy and of the evolutional time of the Galaxy. According to this model, the entire luminosity of the galactic disk becomes almost constant at some 2×10^9 yr after the galactic formation, but the nuclear bulge, whose dimensions gradually diminish, becomes more and more luminous with time. On the other hand, the abundance depletion of helium and heavy elements appears in the inner region of the disk after some 6×10^9 yr of the galactic formation. It also becomes clear that the activity for the nucleosynthesis in the nucleus is limited only in the early history of the Galaxy and has been reduced rapidly with time. Using this model, one can account for the observed phenomena such as the smooth dependence of the elemental abundance in the halo population on the distance from the galactic center, the high abundance of heavy elements in quasar spectra, etc. (auth)

25056 OBSERVATIONS OF MAJOR IONIZATION FRONTS IN M42 AND M8. Elliott, K. H.; Meaburn, J. (Manchester Univ. (UK)). Astrophys. Space Sci.; 28: No. 2, 351-364(Jun 1974).

Image tube filter photographs taken in the light of the low ionization energy [N II] and high ionization energy [O III] lines of the core of M42 are presented. These were taken with the 98-in. Isaac Newton telescope. The whole core of M42 appears to be a complex of ionization fronts. An [N II] photograph of M8 also suggests that the whole of this H II region is composed of a mass of fronts penetrating into a huge neutral region containing dust, gas and molecules. (auth)

25057 A LIST OF PECULIAR GALAXIES, INTERACTING PAIRS, GROUPS AND CLUSTERS SOUTH OF DECLINATION -43°. Sersic, J. L. (Chile Univ., Santiago). Astrophys. Space Sci.; 28: No. 2, 365-373(Jun 1974).

The coordinates, dimensions and short descriptions of 186 objects are given after a search of the Maksutov plate collection in the Observatorio Astronomico, Universidad de Chile, Santiago. (auth)

25058 DECIMETER-WAVELENGTH STUDIES OF HYDROGEN AND CARBON RECOMBINATION LINES TOWARD GALACTIC NEBULAE. Pankonin, V. L. Ithaca, NY; Cornell University (1973). 237p. University Microfilms Order No. 74-10,892.

Thesis (Ph.D.).

New decimeter-wavelength recombination line observations in the lines of sight to selected galactic nebulas are reported. 247α and/or 248α (~0.43 GHz) and 221α (~0.6 GHz) spectra were obtained toward five positions in three well known HII regions visible to the 305-m Arecibo telescope. The sources observed were the A, B, and C components of the W51 complex, W49A, and the G206.0-2.1 component of the Rosette Nebula. These decimeter-wavelength results are used in conjunction with other available experimental evidence to obtain an estimate of the physical conditions within the line-emitting regions. Evidence is presented that the low-frequency hydrogen recombination lines from W49A, W51A, and probably W51B originate in a plasma different from that which produces the high frequency hydrogen lines. Future interpretations of all H line observations of these sources must incorporate multi-density and/or multi-temperature models. The H248α line toward W51C may originate in a fully ionized region or a partially ionized cloud. In either case nonthermal continuum emission in the line of sight to W51C is indicated. There is no conclusive evidence of pressure broadening in any of the observed lines. (RWR)

25059 PROBLEM OF SPIRAL STRUCTURES OF GALAXIES. Marochnik, L. S.; Suchkov, A. A. (Rostov-on-Don State Univ., USSR). Usp. Fiz. Nauk; 112: No. 2, 275-308(Feb 1974). (In Russian).

In section I (introduction) the problem of spiral structure is formulated. Section II reviews the present observational data on the structure of spiral galaxies. Data are presented on the physical composition of spiral limbs, the distribution of stellar and gaseous constituents of the galaxies, and the physical state of the interstellar medium. Section III considers the wave theory of spiral structure. According to present-day concepts the spiral arms are propagated in the galaxy by waves whose frequency is set by some exciting mechanism (by the generator), and the wave number is determined by the dispersion properties of the galaxy. In this approach the rotation velocity of the spiral pattern is equal to the frequency divided by the number of arms, and does not depend on the distance to the center of the galaxy; therefore, the problem of coiling of the spiral arms by differential rotation is removed. The conclusions of the wave theory are considered, and the dispersion equation of spiral waves is presented, on the basis of which a model of the spiral structure of the galaxy is constructed. The problem of exciting and maintaining a spiral pattern is discussed. Section IV considers numerous experiments on modeling galaxies. These experiments indicate the formation of gravitating bits of spiral structures of a wave nature in disk systems. Critical observations are presented on numerous experiments. Arguments for and against the wave theory are presented in the concluding section V. It is noted that this theory has explained a large number of observational facts and that many of its predictions have been confirmed by observations. (7 figures, 150 references) (SJR)

25060 EQUIVALENCE OF BRANDT'S AND TOOMRE'S EXPRESSIONS FOR THE MASS MODEL OF DISK GALAXIES. Aikawa, T. (Tohoku Univ., Sendai). Sci. Rep. Tohoku Univ., First Ser.; 56: No. 2, 14-16(Jul 1973).

It is shown that the expression obtained by Brandt for the mass model of disk galaxies is reduced to that obtained by Toomre and, therefore, both expressions are equivalent. (auth)

25061 STUDY OF THE IONIZATION FRONT IN INTERSTELLAR MAGNETIC FIELDS. Szabados, L. (ELTE Csillagaszati Tanszek, Budapest). Magy. Fiz. Foly.; 22: No. 2, 101-108(1974). (In Hungarian).

Equations are developed for treating stationary and nonstationary ionization fronts. (CES)

25062 UBV SURFACE PHOTOMETRY OF M33 AND M101. Lee, V. J. Bloomington, IN; Indiana University (1973). 228p. University Microfilms Order No. 74-9433.

Thesis (Ph. D.).

The two Hubble class Sc spiral galaxies M33 and M101 are ideal candidates for a test of the Lin and Piddington theories. Photoelectric surface photometry in the UBV system of selected regions of these two galaxies was done to determine if there is any systematic change in the color indices across their spiral arms. Contour maps of both galaxies are presented. The presence of a bar-like structure across the nucleus of M33 is confirmed. Both spiral arms of M33 are visible. There is evidence for an asymmetry in color across the face of M33 with the northeast quadrant redder than the rest of the galaxy by 0.2 m in B – V. There is no evidence for a similar asymmetry in color across M101. Three-dimensional perspective plots of the observations show that there is a striking difference in the appearance of the galaxies in different wavelength regions. A comparison of the optical contour maps with a map of the neutral hydrogen emission of M33 shows that there are no elongated streamers of gas located at the positions of the optical spiral arms. The gas is concentrated in patches with an apparently random distribution over the face of the galaxy. The photometric behavior of the disks of both galaxies is determined in all three wavelength regions. Each galaxy has a disk that becomes progressively bluer with increasing distance from the nucleus. The brightness of the disk is subtracted from the observed magnitude profiles of the galaxy to yield the luminosity contribution of the spiral arm component. (RWR)

Cosmology

Refer also to abstracts 25803.

25063 TIDAL SHAPES AND SHIFTS ON ROTATING BLACK HOLES. Hartle, J.B. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. D 9: No. 10, 2749-2759 (15 May 1974).

The shape of the tide raised on a rotating black hole by an exterior perturbation is investigated. An expression is given for the perturbed curvature of the two-surface formed by the intersection of the event horizon and a surface of constant time. The result involves only the perturbation in the Weyl tensor component ψ_0 which solves the Teukolsky equation. An application is made to the tide raised by an exterior moon outside a slowly rotating black hole. In this case the position of the tidal bulge is shifted away from the position of the moon in a way analogous to the lag of the tide in the earth-moon system. (auth)

25064 GENERALIZED SECOND LAW OF THERMODYNAMICS IN BLACK-HOLE PHYSICS. Bekenstein, J.D. (Center for Relativity Theory, The University of Texas at Austin, Austin, Texas 78712). Phys. Rev. D 9: No. 12, 3292-3300 (15 June 1974).

In previous work we introduced the concept of black-hole entropy which we identified with the surface area of the black hole in question expressed in units of the Planck length squared. We suggested that the appropriate generalization of the second law for a region containing a black hole is: The black-hole entropy plus the common entropy in the black-hole exterior never decreases. Here we establish the validity of this law for the infall of an entropy-bearing system into a much larger and more massive generic stationary black hole. To do this we determine a general lower bound for the increase in black-hole entropy, and an upper bound for the entropy of the system, while allowing for quantum effects at each stage. In passing we show that the generalized second law is a statistical law which becomes overwhelmingly probable in the limit of a macroscopic system. We also consider briefly more general situations. Finally, we give two simple examples of predictions made by the generalized second law for black-hole formation processes. (auth)

25065 MASSES AND SPINS IN CURVED SPACE-TIME. Malin, S. (Department of Physics and Astronomy, Colgate University, Hamilton, New York 13346). Phys. Rev. D 9: No. 12, 3228-3234 (15 June 1974).

The Poincaré and de Sitter groups are well known to imply a deep connection between the structure of space-time and particle properties (mass and spin) for cosmological models with constant four-dimensional curvature. An analogous relationship is constructed for any isophoric, spatially homogeneous cosmological model. The spin is proved to be constant; a time variation of the masses of all physical systems may well exist. It is shown that the variation $m \sim t^{-1}$ which arises in the context of the Friedmann model, is not precluded by present observational and experimental evidence. (auth)

25066 CHARGED COSMOLOGY. Barry, G.W. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). Astrophys. J. 190: No. 2, 279-282 (1 June 1974).

It is proposed that the Universe has a net charge consisting of a uniform intergalactic gas of protons or electrons. No fields are induced if the Universe has Robertson-Walker symmetry. The principal effect is to give the photon a mass equal to the plasma frequency. Application of these ideas to the weak interaction leads to a weak coupling constant which increases with time. (auth)

25067 CAN SUPERNOVAE PRODUCE DEUTERIUM? Epstein, R.I.; Arnett, W.D.; Schramm, D.N. (Department of Astronomy, University of Texas, Austin, Texas 78712). Astrophys. J. Lett. 190: No. 1, L13-L16 (15 May 1974).

An investigation has been made of the nucleosynthesis of the light elements in the shock waves of Type II supernova. The preliminary results basically confirm Colgate's estimates of the energy that is required to produce deuterium. It has also been found that there may be a very large production of ^{7}Li, ^{9}Be, and ^{11}B, in which case Colgate's model is more likely to be a source of these isotopes than of deuterium. Some possible consequences of supernova shock waves on the heavy-element abundances, the cosmic-ray composition, and the diffuse γ-ray background are briefly discussed. (auth)

25068 DOPPLER EFFECT IN GENERAL RELATIVITY. Ganea, I. M. (Astronomical Observatory, Bucharest). Stud. Cercet. Astron.; 19: No. 1, 99-107(1974).

A method due to Synge and Avez is applied to the case of a Schwarzschild field; the method consists in calculating the Doppler effect as in special relativity, by replacing the real source by a fictitious one deduced by parallel transport of source velocity from the source to the observer, along the null geodesic. The exact solution of the equations of parallel transport along the radial null geodesic is given, and this solution is used to find the formulae of gravitational redshift for a source at rest, and of Doppler shift for a source in radial free fall. (auth)

25069 VORTEX FLOW OF MATTER AROUND A SINGULARITY AND A GALACTIC HYPOTHESIS OF JEANS. Wesson, P. S. (Cambridge Univ. (UK)). Astrophys. Space Sci.; 28: No. 2, 289-302(Jun 1974).

When compact objects or black holes move through a fluid medium, or when turbulent plasma and magnetic fields so conspire, a gas flow is set up which closely resembles the flow of water down a plug-hole. A similar hypothesis, but in reverse, was suggested by Jeans in 1928, and would nowadays be referred to as the white hole concept. The dynamics of the flow lead to expressions for the rotational velocity of the fluid far away from and near to the origin of the vorticity. Rotation curves derived from the model are closely akin to actual galactic rotation curves, but observational data on the latter are not precise enough to permit a delineation to be made between (i) flow around a singularity and (ii) flow around a non-singular sink or source. The other acceptable model, that of (iii) a spreading line vortex, is ruled out by comparison with astrophysical observations. The basic analysis for all the models shows that the old problem of the winding-up of spiral arms can be avoided, since the galactic flow system is in a steady state. Jeans' speculation is identified as being a hypothesis compatible with singular vortex flow and so with observation, but perhaps not with the usual interpretation of general relativity metrics, even though the requisite dual space does complete the topology in a mathematically satisfying manner. The predictions of the hypothesis of vortex flow agree with the shape, dynamics and structure of galaxies. (auth)

25070 GRAVITATIONAL RADIATION AND GENERAL RELATIVITY. Sciama, D. W. (International Centre for Theoretical Physics, Trieste, Italy). J. Phys. (Paris), Colloq.; No. 10, 27-31(1973).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

The basic properties of gravitational radiation, as predicted by general relativity, are described and compared with those of electromagnetic radiation. Some recent results on radiative processes in the vicinity of black holes are outlined. It is stressed that some of these processes lead to more efficient methods of converting rest mass into radiative energy than any other known process except matter–antimatter annihilation. Since one would expect there to be a large number of black holes in the universe, these conversion processes may be important in astronomy. Research on gravitational radiation, both theoretical and observational, should therefore be conducted vigorously. (FR)

Planetary Phenomena

Refer also to abstracts 24948 and 25129.

25071 AN EXACT EXPRESSION FOR THE TEMPERATURE STRUCTURE OF A HOMOGENEOUS PLANETARY ATMOSPHERE CONTAINING ISOTROPIC SCATTERERS.

Barkstrom, B.R. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Boulder, Colorado). Astrophys. J. 190: No. 1, 225-235 (15 May 1974).

An exact, analytic expression for the temperature structure in a radiative-equilibrium planetary atmosphere is derived, allowing isotropic scattering of the incident solar radiation. The semi-infinite, plane-parallel atmosphere is assumed to have constant properties, with separate gray opacities for solar and for thermal radiation. The equation of transfer for the solar radiation is solved by using the singular eigenfunction method. Simple expressions are derived for a number of interesting quantities, such as the solar flux, the albedo at a given latitude, and the Bond albedo. The temperature structure is found by using the Green's function for the thermal transport equations, with the solar-flux divergence as a source term. The resulting expression is reduced to more easily understood terms by using identities developed for the solar-radiation solution. The expression for the temperature structure is evaluated using a single scattering albedo (ω_s) of 0.99 for the solar radiation with various ratios (β) of solar to thermal extinction coefficients. Among the interesting phenomena that appear in the computations are a maximum in the solar-flux divergence beneath the top of the atmosphere for normal solar incidence. The position of this maximum rises as the Sun sets. There is also an angle of incidence for which the Eddington approximation for the solar radiation is nearly exact. We conclude that multiple scattering of the solar radiation may increase the greenhouse effect above that predicted for a nonscattering (ω_s=0.0) atmosphere, in spite of the much larger albedo of the scattering atmosphere. In addition, the solar radiation does not have to penetrate to the surface of the planet to give a strong greenhouse effect. (auth)

25072 SODIUM EMISSION COMET MRKOS 1957d. Novikov, G.G. (Institute of Astrophysics, Tadzhik Academy of Sciences, Dushanbe). Sov. Astron.-AJ 50: No. 4, 559-559 (Jan 1974).

The long, linear sodium tail of Comet Mrkos can be explained by allowing for the optical thickness of the comet atmosphere to solar ultraviolet radiation. (auth)

25073 DEUTERIUM ENRICHMENT OF METALLIC HYDROGEN. Hubbard, W.B. (Department of Planetary Sciences, Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona). Astrophys. J. 190: No. 1, 223-224 (15 May 1974).

If there is a first-order phase transition between molecular and metallic hydrogen in the liquid state, a simple statistical-mechanics calculation shows that the metallic phase will be slightly enriched in deuterium. The observed atmospheric deuterium abundance in the giant planets will be affected by at most 15 percent. (auth)

25074 JUPITER'S RADIATION BELTS. Stansberry, K.G.; White, R.S. (Physics Department and Institute of Geophysics and Planetary Physics University of California, Riverside, California 92502). J. Geophys. Res. 79: No. 16, 2331-2342 (1 June 1974).

Fluxes of electrons and protons in Jupiter's radiation belts are calculated with the source (radial diffusion inward from the solar wind) and the loss (synchroton radiation). The calculations are tested against the measured radio wave wavelength distribution, the radio wave distribution with distance from Jupiter, and the degree of polarization of the radio waves. The Fokker-Planck equation is solved by using the method of Farley and Walt with the fixed flux at the outer boundary and the zero flux at Jupiter's surface. We find, in agreement with Brice and McDonough, Jacques and Davis, and Brimingham et al., that the usual magnetic and electric diffusions, which vary as L^{10} and L^6, respectively, are insufficient to furnish the required electrons and that the diffusion driven by ionospheric winds of Brice and McDonough is strong enough to furnish Jupiter's belts. An additional loss mechanism close to Jupiter is required to remove the electrons, particularly those at low energies. Our model gives a maximum flux of 1.4×10^9 el/cm^2 s at L=2.7, where the characteristic energy is 7 MeV. The same ionospheric wind diffusion for the protons without the synchrotron and low-altitude losses gives a peak flux of 1.8×10^{10} protons/cm^2 s at L=1.3, where the characteristic energy is 340 MeV. (auth)

25075 THERMOLUMINESCENCE STUDIES OF THE IRRADIATION HISTORY OF LUNAR ROCKS. Hoyt, H. P. Jr. Seattle; Washington University (1973). 122p. University Microfilms Order No. 74-7044.

Thesis (Ph. D.).

The general characteristics of the thermoluminescence (TL) of lunar samples are described and indicate that the TL measured represents a dynamic equilibrium between buildup from ionizing radiation and loss due to thermal draining. Differences between levels for various samples are interpreted as reflecting differences in average lunar dose rate and temperature. The thermal behavior of small rocks ($\lesssim$10 cm) on the lunar surface is considered, and it is shown that their temperature changes so slowly that large gradients do not build up. Therefore, the variation of TL with depth reflects only the variation of dose rate and is used to obtain the solar flare proton spectrum averaged over the TL equilibrium time. The dose-rate depth profile in lunar rocks is produced by three sources: radiations from primordial radionuclides (U, Th, K), galactic cosmic rays, and solar flare protons. It is shown that the contribution from the first two sources changes by less than 4% in the top 15 g/cm^2. The dose-rate depth profile produced by solar flare protons with a differential energy spectrum of the form $dJ/dE = KE^{-\gamma}$ is calculated as a function of γ. (LBS)

25076 SHOCK-WAVE PROPAGATION IN THE INTERPLANETARY MEDIUM. II. Krymskii, G. F.; Transkii, I. A. (Inst. of Space Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 660-663 (1973).

Translated from Geomagn. Aeron.; 13: No. 5, 777-781(1973).

A model of a point explosion is used to investigate the geometry of shock waves in interplanetary space. The condition of zero gas pressure gradient behind the wave front is used in the model. It is demonstrated that the direction of propagation of the shock front can deviate by large angles from the radial direction. (auth)

25077 SECTOR STRUCTURE OF THE INTERPLANETARY MAGNETIC FIELD DURING THE IGY AND IGC. Mansurov, S. M.; Mansurova, L. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 674-678(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 794-800(1973).

The geomagnetic effect of the sector structure of the interplanetary magnetic field is described. It is shown that this effect has a north-to-south and a spring-to-autumn asymmetry. The signs of the sectors of the interplanetary magnetic field are determined for the period April 1957 to December 1959. (auth)

25078 INTERPLANETARY MAGNETIC FIELD, RECONNECTION, AND THE STRUCTURE OF MAGNETOSPHERIC STORMS. Ivanov, K. G.; Mikerina, N. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 754-757(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 891-895(1973).

The normal component of the interplanetary magnetic field and the reconnection rate are compared with the disturbance field in the region of the westerly electrojet. The view of a storm as a sequence of substorms is confirmed. It is demonstrated that, in agreement with the "discontinuous" scheme of reconnection, the increase in the reconnection rate considerably reduces the interval between substorms and changes the shape of these storms qualitatively. (auth)

25079 CONVECTION OF LOW-ENERGY SOLAR PROTONS BEHIND AN EXPLOSIVE WAVE FRONT IN INTERPLANETARY SPACE. Nikolayev, Yu. M. (Moscow State Univ.). 13: No. 5, 776-777(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 917(1973).

The nonsteady convection of solar protons behind the front of a strong explosive wave propagating radially from the sun is investigated using the following theoretical model. A spherical shock wave travels from the region of the explosion along a quiet solar wind whose density decreases as $\rho_0 \sim r^{-w}$ and creates a disturbance region between the sun r = 0 and front $r \leq r_f$. (JFP)

25080 ORIGIN OF JOVIAN DECAMETER WAVE EMISSIONS. Conversion from the Electron Cyclotron Plasma Wave to the Ordinary Mode Electromagnetic Wave. Oya, H. (Kyoto Univ.). Planet. Space Sci.; 22: No. 5, 687-708(May 1974).

Energy conversion rates from the extraordinary mode to the ordinary mode of the electromagnetic waves in the Jovian plasmasphere have been calculated for a model of the sharp boundary that is given in the vicinity of the position where $w = \omega_p$, for an angular frequency ω and the angular plasma frequency ω_p. The extraordinary mode electromagnetic wave that is obtained as a result of the transformation of a longitudinal plasma wave propagating through an inhomogeneous plasma is here considered. The results give conversion rates of 1 to 50%, at the most, when a wave normal direction of an incident wave is nearly parallel to the boundary normal direction and when the Jovian magnetic field vector is close to the boundary normal direction within an angle range from 10° to 15°. The electric field intensity, in a range from 7 to 70 mV/m, of the original electrostatic electron cyclotron plasma waves can give the power flux in a range from 10^{-22} to 10^{-20} W/m^{2}Hz for the Jovian decameter waves observed at the Earth's surface. Efficient energy conversion is possible only when the ray direction of the emitted wave is in nearly perpendicular direction with respect to the magnetic field; this is the origin of the sharp beam emission of the Jovian decameter wave burst. (auth)

25081 NEUTRAL AND ION EXOSPHERE MODELS FOR LUNAR HYDROGEN AND HELIUM. Hartle, R. E.; (Goddard Space Flight Center, Greenbelt, MD); Thomas, G. E. J. Geophys. Res.; 79: No. 10, 1519-1526(1 Apr 1974).

A general neutral exosphere model, which includes density and temperature variations at the exobase, is applied to the moon to obtain surface and radial density distributions for H, H_2, and He. It is assumed that the source for these constituents derives from accretion of solar wind ions. The surface distributions are determined by requiring that the sum of the neutral and solar wind ion fluxes for a given constituent vanish at all points on the surface. On this basis, maximum day side surface densities for H (23 cm^{-3}), H_2 (4.2×10^3 cm^{-3}), and He (1.2×10^3 cm^{-3}) and maximum night side surface densities for H (13 cm^{-3}), H_2 (1.3×10^4 cm^{-3}), and He (2.2×10^4 cm^{-3}) that are consistent with either measured values or upper limits are obtained. In addition, model ion density distributions for H_2^+ and He^+ are constructed. This ion exosphere is produced by ionization of the neutral exosphere in the solar wind, which efficiently sweeps the ions past or onto the lunar surface. Saturated H_2^+ and He^+ densities ranging from about 10^{-3} to 1.5×10^{-2} cm^{-2} and 3×10^{-5} to 4×10^{-4} cm^{-3} over 1.5-3 selenocentric radii on the day side, respectively are obtained. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

25082 (AD-744523) IONOSPHERIC HEATING ANALYSIS: hf PLASMA LINE ENHANCEMENTS AT ARECIBO. Final Technical Report, 1 October 1970–1 December 1971. Gordon, W. E.; Carlson, H. C.; Showen, R. L. (Rice Univ., Houston, Tex. (USA)). Feb 1972. Contract F30602-71-C-0155. 16p. (RADC-TR-72-120). NTIS $3.00.

The nonlinear enhancement of the plasma line was observed in January 1971 by Carlson, Gordon and Showen (JGR 1972). The enhancement spectrum includes: a strong narrow line displaced below the HF (5.62 MHz) by the frequency of the ion acoustic waves (f_i) in the plasma (about 4 kHz); a broader line (about 30 kc width) and other weak lines near the HF; a line near (f_i). Enhancements above thermal levels range above a factor of 10,000 and may be taken as verification of the HF excitation of parametric instabilities in the ionosphere. Significant time variations over scales of tens of microseconds through hours were seen. Upshited and downshifted power dependence, and decay rates (of the order of msec). The O-mode (but not the X-mode) excitation of these enhancements is of significance to heating experiments. (GRA)

25083 (AD-760044) IONOSPHERIC MODELING. Quarterly Technical Report. Megill, L. R. (Utah State Univ., Logan (USA)). 1973. Contract N00014-67-A-0220-0004. 11p. NTIS $3.00.

A computer code was developed that will calculate the time-varying, vertical ionization distribution between 100 and 600 kilometers altitude for the polar ionosphere. The code produces ionization from both the solar ultraviolet flux and by auroral electron precipitation down the geomagnetic field lines. The distribution of ionization into the various ion species is traced through ion-chemical reactions, which are specified by the user. At present, 66 reactions can be accommodated. The ion-chemical reactions form a set of production and loss terms, which can be folded into the species continuity equations to calculate the time variable species density. (NTIS)

25084 (AD-764662) IONOSPHERIC MODELING. Quarterly Technical Report No. 2, January–31 March 1973. Megill, L. R. (Utah State Univ., Logan (USA)). 31 Mar 1973. Contract N00014-67-A-0220-0004. 9p. NTIS $2.75.

The results that are given are outputs from a previous computer program. The philosophy for modeling the very complex D region was explained in the previous quarterly report. A subroutine to calculate the ion-electron pair production due to precipitating protons and alpha particles was converted from the (PAMATRX) computed program discussed by Adams and Masley (1965). This program is also described in the Ionospheric Modeling Newsletter of May 10, 1973. The technique for calculating the D region ionization due to precipitating electrons is the same as that for the E and F regions described previously. However, the computer subroutine is being modified slightly to be compatible with the proton subroutine in order to conserve computer time. (GRA)

25085 (AD-775591/1) COUPLED BARIUM CLOUD–IONOSPHERE SYSTEMS. 2. Conductivity Ratio Effects. Scannapieco, A. J.; Ossakow, S. L.; Book, D. L.; Goldman, S. R. (Naval Research Lab., Washington, D. C. (USA)). Mar 1974. 13p. (NRL-MR-2743). NTIS $3.00.

The nonlinear motion of an f-region barium release electrostatically coupled to the e region is studied numerically. The effect of varying the conductivity ratio summation p to b/summation p to I and the formation of striations are discussed. (GRA)

25086 (AD-775596/0) PARALLEL PROPAGATION EFFECTS ON THE TYPE I ELECTROJET INSTABILITY. Ossakow, S. L.; Papadopoulos, K.; Orens, J. H.; Coffey, T. P. (Naval Research Lab., Washington, D. C. (USA)). Mar 1974. 28p. (NRL-MR-2750). NTIS $3.25.

The Farley-Buneman instability has been extended to consider higher frequency, shorter wavelength modes (thus including finite Debye length effects) while allowing these modes to propagate with a component parallel to the magnetic field (k parallel not = 0). By driving the current sufficiently hard (drift speeds in the range 2 to 3 times the ion thermal velocity, VI) the growth rates of these modes maximize slightly away from the perpendicular to the magnetic field showing the importance of k parallel not = 0. Although the wavelengths of these maximum growing modes are in the regime of several to tens of centimeters, the phase velocities are near the ion thermal velocity. This suggests that a nonlinear coupling of these off angle modes may be responsible for the observed radar spectrum with maximum intensity near VI and wavelengths in the 1 to 10 meter regime. Maximum growth rates of off angle propagation while varying the densities and collision frequencies are shown. Also, growth rates of unstable waves in the radar regime (1 to 10 meters) are shown for drift velocities 1.5 and 3 times VI. (GRA)

25087 (AD-776211/5) AURORAL EMISSION AND INELASTIC ELECTRON COLLISION PROCESSES IN AIR. Ali, A. W. (Naval Research Lab., Washington, D. C. (USA)). Nov 1973. 25p. (NRL-MR-2742). NTIS $4.25.

A survey of the auroral emissions and all inelastic electron collision processes in N_2, O_2, O and NO is made. It is intended to show the available experimental and theoretical data on the relevant cross sections and point out the need for data where none exists. (GRA)

25088 (AD-776276/8) ELECTRIC AND MAGNETIC FIELD OBSERVATIONS DURING A SUBSTORM ON FEBRUARY 24, 1970. Gurnett, D. A.; Akasofu, S. I. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Feb 1974. 20p. NTIS $3.00.

A series of electric field measurements obtained from the Injun 5 satellite and simultaneous magnetic disturbance observed in the interplanetary medium and on the ground during a magnetic substorm are reported. The substorm analyzed took place on February 24, 1970. Prior to the onset of the substorm a greatly enhanced anti-sunward plasma flow was observed over the polar cap. The enhanced plasma flow occurred about 30 minutes after a switch in the direction of the interplanetary magnetic field from northward to southward. (GRA)

25089 (COO-2081-18) STIMULATED DIFFUSION SCATTERING IN IONOSPHERIC MODIFICATION. Berger, R. L.; Goldman, M. V.; DuBois, D. F. (Colorado Univ., Boulder (USA); Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1974. Contract AT(11-1)-2081. 33p. Dep. NTIS $4.75.

A linear stability theory is presented for stimulated backscattering of 0-mode radiation from "diffusion modes." The uncoupled diffusion mode is an electrostatic spatially periodic disturbance which relaxes at the parallel or cross-magnetic field diffusion rate. For ionospheric modification experiment parameters, the most unstable diffusion mode is within one degree of orthogonal to the geomagnetic field, and is characterized by the parallel diffusion rate. It is found to have a maximum temporal growth rate of 20 sec^{-1} and a wavelength of 100 meters or more at altitudes several tens of kilometers below the 0-wave reflection point. The total spatial amplification is calculated for special geometries. (auth)

25090 (WRE-TM-A-239(AP)) IONOSPHERIC TILTS AND TIDS NEAR THE MAGNETIC EQUATOR. Treharne, R. F. (Weapons Research Establishment, Salisbury (Australia)). Oct 1973. 13p. Dep. NTIS (U. S. Sales Only) $4.00.

A few observations made near the magnetic dip equator show daytime tilts in the F region of the ionosphere to the east and which reverse direction at sunset. During the evening, if spread F is absent, large steady tilts which peak at 2100 hours local time are seen, north in winter, east and west in summer. In addition the effects of TID's may be seen to be superimposed on the post sunset peak. The direction, speed, wavelength and amplitudes of these TID's have been estimated by a single station method. These results were presented at a conference in Cheltenham, England in May 1973. (auth)

25091 (WRE-TM-A-242(AP)) COMPUTER SIMULATION OF TIME-VARYING ANGLE OF ARRIVAL AND DOPPLER SHIFT ASSOCIATED WITH TID'S. George, P. L.; Miller, J. (Weapons Research Establishment, Salisbury (Australia)). Nov 1973. 15p. Dep. NTIS (U. S. Sales Only) $4.00.

The results of a computer simulation of hf skywaves in a perturbed ionosphere are presented. Variations in Doppler Shift and angle of arrival are compared at both normal and oblique incidence. Attention is drawn to the appearance of multiple ray paths and to the dependence of the oblique path effects upon the direction of travel of the TID with respect to the propagation path. (auth)

25092 CORONAL LAMBDA 5303 INTENSITY, GEOMAGNETIC ACTIVITY AND SOLAR SOURCES OF HIGH-SPEED PLASMA STREAMS. Gulbrandsen, A. Planet. Space Sci.; 22: No. 5, 841-857 (May 1974).

Investigations during the last 30 yr of the relationship between

the green emission line corona and geomagnetism have yielded contradictory results. The papers on this subject can be separated into 2 groups; (a) papers reporting a negative correlation between green line intensity and geomagnetic activity, and (b) papers reporting a positive correlation. The negative correlation seems to be the one better supported by solar wind theory and observations. It implies that solar active regions are the base of low expansion speeds, whereas quasi-stationary high-speed solar plasma streams originate from regions of low density and open magnetic field structures. In the present paper some of the analyses described in the group (b) papers are re-examined. It is found that instead of indicating a positive correlation, these analyses in fact favor the negative correlation. Thus there does not appear to be any conflict at all between the different papers. The interpretation in favor of the positive correlation seems to be due to some accident of perspective having obscured the true connection. (auth)

25093 PROTON CYCLOTRON FREQUENCY PHENOMENA IN THE TOPSIDE IONOSPHERE. Horita, R. E. (Univ. of Victoria, British Columbia). Planet. Space Sci.; 22: No. 5, 793-799(May 1974).

Proton cyclotron echoes and spurs are phenomena related to the proton cyclotron frequency discovered on topside sounder ionograms from the Canadian Alouette satellites. The echoes and spurs appear on the ionograms at apparent ranges which each lead to a frequency close to the proton cyclotron frequency; the frequency is obtained by taking the reciprocal of the time elapsed between the transmission of the sounder pulse and the reception of the signal at the satellite. Alouette II and ISIS I and II ionograms for about sixty satellite passes were scaled to study the characteristics of these phenomena. Generally, proton cyclotron echoes and spurs occurred on the ionograms at frequencies below the electron plasma frequency f_N, the echoes predominantly slightly above the electron cyclotron frequency f_H and the spurs just below f_N. They appeared most often when a harmonic of the electron cyclotron frequency $nf_H (n = 1, 2, 3, 4)$ was approximately equal to one of the other characteristic frequencies, that is: (1) $nf_H \approx f_H$, (2) $nf_H \approx f_s$, the frequency of the Z wave at the height of the satellite, and (3) $nf_H \approx f_T$, the upper hybrid resonance frequency. (auth)

25094 ROCHE-LIMIT OF IONOSPHERIC PLASMA AND THE FORMATION OF THE PLASMAPAUSE. Lemaire, J. (Institut d'Aeronomie Spatiale de Belgique, Brussels). Planet. Space Sci.; 22: No. 5, 757-766(May 1974).

The plasmapause position is determined by the innermost equipotential surface which is tangent to the "Roche-Limit" surface of the ionospheric plasma filling the magnetosphere. When the thermal particles corotate with the Earth's angular velocity, the "Roche-Limit" equatorial distance is $L_c = 5.78[R_E]$. When the angular convection velocity is evaluated from the quiet time electric field distribution E3 of McIlwain (Earth's Magnetospheric Processes. Reidel, Dordrecht, Holland 268-279. (1972)), L_c depends on the local time. Its minimum value is then $L_c = 4.5$ near 2400 LT, and the plasmapause shape and position satisfactorily fit the observations. The diffusive equilibrium density distribution appropriated inside the plasmasphere becomes convectively unstable beyond $L = L_c$, where the collisionless type of model satisfactorily represents the observations. In the intermediate region between the plasmapause and the last closed magnetic field line, continuous ionization fluxes are expected to flow out of the midlatitude ionosphere. (UK)

25095 PHOTOMETRIC MEASUREMENTS OF H-BETA IN THE AURORA. Romick, G. J.; Belon, A. E.; Stringer, W. J. (Univ. of Alaska, College). Planet. Space Sci.; 22: No. 5, 725-733(May 1974).

Measurements of auroral H-beta at high temporal and spatial resolution obtained by means of an interference filter scanning photometer have been subjected to a detailed analysis regarding possible sources of signal contamination. Two general categories of potential contamination were investigated: (1) strong spectral emissions within the "wings" of the filter passband and (2) weak molecular bands, atomic lines or continuum underlying the H-beta line and therefore contributing to the light passed by the filter. Calculation of the apparent intensity resulting from contamination in the first category yielded an upper limit of 10 R false H-beta signal for the brightest auroral conditions when H-beta intensities are on the order of 1 kR. Estimates of intensities resulting from contamination of the second category were calculated from two points of view: (a) examination of spectral morphology, with a result that 60 to 70% of the signal recorded is true H-beta and (b) estimation of individual contaminating emissions with a result that at least 65% of the recorded signal is auroral H-beta. (auth)

25096 APPARENT ENHANCEMENT OF ELECTRON TEMPERATURE IN THE WAKE OF A SPHERICAL PROBE IN A FLOWING PLASMA. Illiano, J. M.; Storey, L. R. O. (CNRS, Orleans-La-Source, France). Planet. Space Sci.; 22: No. 5, 873-878(May 1974).

An apparent enhancement of electron temperature has been observed in the wake of a conducting sphere in a flowing laboratory plasma, using as a probe a segment of the sphere itself. It is considered to be due to the negative potential well that is present in the wake and which causes the velocity distribution of the electrons collected on the rear hemisphere to be non-Maxwellian. This interpretation of the phenomenon has been checked by numerical simulation. (auth)

25097 MOTION AND MAGNETIC STRUCTURE OF THE PLASMA SHEET NEAR $30R_E$. Bowling, S. B.; Wolf, R. A. (Rice Univ., Houston, TX). Planet. Space Sci.; 22: No. 5, 673-686(May 1974).

Data taken by the NASA-GSFC magnetometer aboard the Explorer 34 satellite are analyzed in an effort to ascertain the average motion and magnetic field structure of the plasma sheet near $30R_E$. It is found that the flapping motion of the plasma sheet in the solar ecliptic Z-coordinate is characterized by a typical speed of 90 km/sec and an amplitude of $\pm 2R_E$. Results suggest that there exists a layer of nearly uniform cross-tail current density in the central region of the plasma sheet approx 2.3 to $2.6R_E$ thick within which the solar-magnetospheric X-component of the magnetic field changes from 10γ to -10γ. Near the center of the plasma sheet, the average value of the Z-component of the field is 2γ. The analysis does not suggest a strong dependence of the magnetic-field configuration on K_p. (auth)

25098 6300 A $O(^1\bar{D})$ AIRGLOW AND DISSOCIATIVE RECOMBINATION. Wickwar, V. B. (Stanford Research Inst., Menlo Park, CA); Cogger, L. L.; Carlson, H. C. Planet. Space Sci.; 22: No. 5, 709-724(May 1974).

Measurements of night-time 6300 Å airglow intensities at the Arecibo Observatory have been compared with dissociative recombination calculations based on electron densities derived from simultaneous incoherent backscatter measurements. The agreement indicates that the nightglow can be fully accounted for by dissociative recombination. The comparisons are examined to determine the importance of quenching, heavy ions, ionization above the F-layer peak, and the temperature parameter of the model atmosphere. Comparable fits between the observed and calculated intensities are found for several available model atmospheres (e.g. CIRA, Jacchia). The least-squares fitting process, used to make the comparisons, produces comparable fits over a wide range of combinations of neutral densities and of reaction constants. Yet, the fitting places constraints upon the possible combinations; these constraints indicate that the latest laboratory chemical constants and densities extrapolated to a base altitude are mutually consistent. However, by imposing an additional constraint, an aeronomically derived preference is given for about one $O(^1D)$ per recombination. A preference is also given for the lower base densities of O_2 derived from rockets rather than from models. Altitude profiles for the 6300 Å and 5577 Å emissions are deduced. In the early evening, there are no large discrepancies in the fits that might indicate an effect from excited states of O^+, vibrational excitation of O_2, or both. The technique of comparing observed and calculated 6300 Å intensities has considerable potential as an aeronomical tool for examination of other possible sources of emission and for determination of relative changes in the neutral atmosphere. (auth)

25099 IMPLICATIONS OF LOW ALTITUDE OBSERVATIONS OF ISOTROPIC PRECIPITATION OF RING CURRENT PROTONS BEYOND THE PLASMAPAUSE. Bernstein, W. (National Oceanic and Atmospheric Administration, Boulder, CO); Hultqvist, B.; Borg, H. Planet. Space Sci.; 22: No. 5, 767-776(May 1974).

The precipitation patterns of 6 keV protons at 10° and 80° pitch angles have been mapped at altitudes <1500 km from the ESRO 1A and 1B spacecraft. Equatorward of the trapping boundary, a region of isotropic precipitation, bounded on its equatorward border by a region of anisotropic (depleted loss cone) precipitation, is always observed. The latitudinal location of this transition appears to be nearly spatially coincident with the plasmapause. Similar precipitation patterns are shown to exist for higher energy protons. The general absence of enhanced precipitation at the plasmapause suggests that the inner boundary of the ring current is not usually produced by an enhanced proton pitch angle diffusion process. The isotropic precipitation observed beyond the plasmapause is most consistent with the occurrence of an electrostatic instability throughout the ring current zone. It is doubtful whether the proposed cold Li plasma seeding experiments beyond the plasmapause could significantly increase the observed natural proton precipitation rates. (auth)

25100 NONLINEAR FREQUENCY SHIFT AND SELF-MODULATION OF THE QUASI-MONOCHROMATIC WHISTLERS IN THE IN-

HOMOGENEOUS PLASMA (MAGNETOSPHERE). Karpman, V. I.; Istomin, J. N.; Shklyar, D. R. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Planet. Space Sci.; 22: No. 5, 859-871(May 1974).

The nonlinear frequency shift arising from the interaction of the quasimonochromatic whistler-mode wave with resonant particles in an inhomogeneous plasma is derived. The modulational instability caused by this shift is investigated. The results are applied to the propagation of long-duration VLF whistler-mode signals along the magnetic field in the magnetosphere. It is shown that the modulational instability of these waves in the equatorial region leads to pulsations very similar to those observed experimentally. (auth)

25101 POLAR CAP AURORAL ELECTRON FLUXES OBSERVED WITH ISIS 1. Winningham, J.D.; Heikkila, W.J. (University of Texas at Dallas, Dallas, Texas 75230). J. Geophys. Res. 79: No. 7, 949-958 (1 Mar 1974).

Three types of auroral particle precipitation have been observed over the polar caps, well inside the auroral oval, by means of the soft particle spectrometer on the Isis 1 satellite. The first type is a uniform, very soft (~100 eV) electron 'polar rain' over the entire polar cap; this may well be present with very weak intensity ($\approx 10^{-3}$ erg cm^{-2} s^{-1}) at all times, but it is markedly enhanced during worldwide geomagnetic storms, when it can reach 10^{-2} erg cm^{-2} s^{-1}. It appears to be the cause of the background glow at 6300 Å, which has been observed by means of photometers. The energy spectrum of the polar rain is like that of the magnetosheath flux observed in the dayside cusp of cleft, a fact suggesting that it is of magnetosheath (i.e., solar wind) origin. A second type of precipitation is a structured flux of electrons with energies near 1 keV, suggestive of localized 'polar showers'; it seems likely that these are the cause of the sun-aligned auroral arcs that have been observed during moderately quiet conditions. During periods of intense magnetic disturbance this precipitation can become very intense and exhibit a characteristic pattern that we have come to call a 'polar squall'. The field-aligned distribution, the sharpness of the energy spectrum, and the lack of protons sugggest that the particles may be energized by a parallel electric field. Additional evidence for such a parallel electric field exists in the form of a downward or return flux of atmospheric photoelectrons observed over the polar cap only in the presence of a squall. (auth)

25102 ION COMPOSITION AND DRIFT OBSERVATIONS IN THE NIGHTTIME EQUATORIAL IONOSPHERE. Goldberg, R.A.; Aikin, A.C. (Laboratory for Planetary Atmospheres, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771), Krishna Murthy, B.V. J. Geophys. Res. 79: No. 16, 2473-2478 (1 June 1974).

The first in situ measurements of ion composition in the nighttime equatorial E and F region ionospheres (90-300 km) are presented and discussed. These profiles were obtained by two rocket-borne ion mass spectrometers launched from Thumba, India, on March 9-10, 1970, at solar zenith angles of 112° and 165°. Ionosonde data established that the composition was measured at times bounding a period of F region downward drift. During this period the ions O^+ and N^+ were enhanced by 1-3 orders of magnitude between 220 and 300 km. Below the drift region (200 km), O^+ ceased to be the major ionic constituent, but the concentrations of O^+ and N^+ remained larger than predicted from known radiation sources and loss processes. Here also, both the O_2^+ and the NO^+ profiles retained nearly the same shape and magnitude throughout the night in agreement with theories assuming scattered UV radiation to be the maintaining source. Light metallic ions, including Mg^+, Na^+, and possibly Si^+, were observed to altitudes approaching 300 km, whereas the heavier ions Ca^+ and K^+ were seen in reduced quantity to 200 km. All metallic ion profiles exhibited changes that can be ascribed to vertical drifting. (auth)

25103 THE k SPECTRUM OF IONOSPHERIC IRREGULARITIES. Ott, E.; Farley, D.T. (School of Electrical Engineering, Cornell University, Ithaca, New York 14850). J. Geophys. Res. 79: No. 16, 2469-2472 (1 June 1974).

Dimensional analysis is applied to the E×B gradient drift plasma instability, which appears to be responsible for various ionospheric irregularities (e.g., type 2 irregularities in the equatorial E region) in which the perturbations first develop at long wavelengths and then cascade down to smaller scale sizes. We find that the power spectrum must be of the form $f(kL_N, V_d/kD_a, \Theta)k^{-1}$, where k is the wave number. L_N is the density gradient length, V_d is the electron drift velocity relative to the ions. D_a is the ambipolar diffusion coefficient, and Θ decribes the direction of k relative to V_d. This implies, for example, that if the spectrum is proportional to V_d^2, as is apparently the case for the equatorial type 2 irregularities, the spectrum must decrease with k at least as fast as k^{-3}. (auth)

25104 OBSERVATIONS OF NEUTRAL WINDS IN THE AURORAL E REGION DURING THE MAGNETOSPHERIC STORM OF AUGUST 3-9, 1972. Brekke, A.; Doupnik, J.R.; Banks, P.M. (Department of Applied Physics and Information Science, University of California, San Diego La Jolla, California 92037). J. Geophys. Res. 79: No. 16, 2448-2456 (1 June 1974).

Auroral zone E region neutral winds have been derived from simultaneous measurements of ion drift velocities in different altitudes by the incoherent radar facility at Chatanika, Alaska (L=5.6, Λ=65°), on a quiet day before and during the great magnetospheric storm of August 3-9, 1972. The neutral wind expected for a day-night pressure asymmetry appears to be strongly opposed by ion drag and local pressure gradients in the auroral oval. (auth)

25105 ION COMPOSITION IN AN IBC CLASS II AURORA 2. MODEL. Swider, W.; Narcisi, R.S. (Air Force Cambridge Research Laboratories, Massachusetts 01730). J. Geophys. Res. 79: No. 19, 2849-2852 (1 July 1974).

Relatively good agreement is obtained between the ion composition measurements for a steady class II aurora and a simple auroral model. Better agreement would require a more precise neutral model for N_2, O_2, O, and NO. Auroral ion composition model computations were performed by using the mean Cira (1965) and the Jacchia (1971) 800° K thermopause neutral models as extremes. The computations suggest that the true N_2, O_2, and O concentrations lie between these two models in contrast to a previous study of a class 1 aurora, which suggest a higher O/O_2 ratio than either model. The required O/O_2 ratio is found to increase in proportion to the fraction of atomic oxygen ions formed in metastable states. The peak NO concentration, about 4×10^5 cm^{-3} model employed in the computations. The deduced nitric oxide profile agrees with the profile deduced earlier for the class I aurora within the estimated uncertainties for both profiles. (auth)

25106 PRECIPITATING ELECTRON FLUXES FORMED BY A MAGNETIC FIELD ALIGNED POTENTIAL DIFFERENCE. Evans, D.S. (NOAA Space Environmental Laboratory, Boulder, Coloroda 80302). J. Geophys. Res. 79: No. 19, 2853-2858 (1 July 1974).

A model is developed in which a magnetic field aligned potential difference is assumed to accelerate electrons downward into the atmosphere. It is pointed out that the upgoing backscattered electrons produced by this electron beam may process insufficient kinetic energy to overcome the hypothetical potential difference. These electrons will be reflected downward to appear as members of a precipitating electron population. A numerical model was constructed in order to describe the total precipitating electron flux in terms of a primary accelerated beam and backscatter from the atmosphere. It is pointed out that many features that appear in the model beam are observed in the auroral electron beam as well. An example of an auroral beam, measured by Frank and Ackerson (1971), is compared favorably with a model electron beam formed by a parallel potential. (auth)

25107 OBSERVATIONS OF IONOSPHERIC ION FLOW AND RELATED CONVECTIVE ELECTRIC FIELDS IN AND NEAR AN AURORAL ARC. Whalen, B.A.; Green, D.W.; McDiarmid, I.B. (Division of Physics, National Research Council of Canada, Ottawa, Ontario, Canada). J. Geophys. Res. 79: No. 19, 2835-2842 (1 July 1974).

Measurements of the ionospheric ion distribution function and energetic electron and ion precipitation during an auroral substorm near local midnight are presented. Thermal ion measurements are used to determine the ion bulk flow velocity, temperature, and density. It is shown that the ion flow velocity is highly correlated with energetic electron precipitation. The convective component (perpendicular to the logical magnetic field B) was found to be large (equivalent electric field $E_1 \sim 100$-200 m V/m) poleward of a series of poleward expanding arcs. Inside the arc the convective flow dropped to a low value ($E_1 \sim 10$-30 m V/m). High-velocity (~ 2km/s) ion flows parallel to B were also found to be correlated with electron precipitation. Poleward of the arc the flow was directed away from the ionosphere, whereas inside the arc the flow switched to earthward. Parallel electric fields of ~0.1 m V/m required to produce these vertical flows are shown to be consistent with energetic pitch angle distributions. Convective electric field measurements reported here are compared with previous observations. (auth)

25108 ION COMPOSITION IN AN IBC CLASS II AURORA 1. MEASUREMENTS. Narcisi, R.S.; Sherman, C.; Wlodyka, L.E.; Ulwick, J.C. (Air Force Cambridge Research Laboratories, Bedford, Massachusetts 01730). J. Geophys. Res. 79: No. 19, 2843-2848 (1 July 1974).

A positive ion mass spectrometer was included in a Black Brant rocket pay load fired from Poker Flat, Alaska, on March 16, 1972, in the Ice Cap 72 program. Measurements were obtained between 100 and 145 km on ascent and down to 72 km on descent during a diffuse IBC class II auroral event. Within the 1-to 38-amu mass range of the instrument the following species (listed in order of decreasing concentrations) were measured in the E region: NO^+, O_2^+, O^+, N_2^+, $^{16}O^{18}O^+$, N^+, Mg^+, and Na^+ along with the contaminants OH^+, H_2O^+, and H_3O^+, which made up less than or about 1% of the total ionization. The D region water cluster ions H_5O_2 and H_3O^+ appeared at 84 km on the downleg and dominated below 81 km. Ion-electron densities were $2\text{-}4\times10^3$ cm^{-3} between 110 and 145 km. Measurement uncertainties and possible sources of the contaminant ions are discussed. (auth)

25109 A MORPHOLOGICAL STUDY OF SUBSTORM-ASSOCIATED DISTURBANCES IN THE IONOSPHERE. Park, C.G. (Radioscience Laboratory, Stamford University, Stanford, California 94305). J. Geophys. Res. 79: No. 19, 2821-2828 (1 July 1974).

The whistler technique was used in an earlier study to observe a rapid depletion of the day side plasmasphere during isolated substorm activity on June 25, 1965 (Park, 1973). It was inferred that this depletion was due to dumping of plasma into the underlying ionosphere. The average downward flux was estimated to be of the order of 10^9 el/cm^2 s across the 1000-km level, large enough to cause significant enhancements in electron concentrations in the ionospheric F region. In this paper the ionospheric behavior during the same event is examined by using ionosonde data from some 40 stations in the northern hemisphere. The results show that the F_2 layer critical frequency f_0F_2 was enhanced up to 25% above the monthly median level in the same general area where downward fluxes were inferred from whistlers. This was followed by ~20% depressions in f_0F_2 the next day, when geomagnetic conditions were quiet. These substorm effects were observed in a wide range of latitude but were limited in local time and longitude. In the area affected, the ionospheric disturbance caused by this moderate substorm activity (~500γ maximum AE index and ~6-hour duration) was similar in many respects to major worldwide ionospheric storms. These results support the view that ionospheric storms can be understood in terms of the superposed effects of many substorms. (auth)

25110 THE MIDDAY RED AURORA OBSERVED AT THE SOUTH POLE ON AUGUST 5, 1972. Akasofu, S. (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701). J. Geophys. Res. 79: No. 19, 2904-2910 (1 July 1974).

A spectacular red aurora was observed and recorded by an all-sky camera at the Amundsen-Scott base between 1400 and 1800 UT on August 5, 1972. Since magnetic noon is about 1530 UT there and since the intense storm of August 4-5, 1972, was in progress at the time, there is no doubt that the red aurora was a magnetic midday phenomenon associated with an extremely intense substorm during the storm. The Dapp (U.S. Air Force Data Acquisition Program) satellite photographs are also used in examining activity during the event. (auth)

25111 SEASONAL, NONSEASONAL, AND SEMI-ANNUAL VARIATIONS OF THE N(h) PARAMETERS OF THE F2-LAYER AT NOON. Anufrieva, T. A.; Shapiro, B. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 703-707 (1973).

Translated from Geomagn. Aeron.; 13: No. 5, 829-834(1973).

The seasonal S, nonseasonal A, and semi-annual B (or b) components of the annual variations of the noon values of f_0, h_{max}, and y_m at middle and low latitudes are analyzed. It is found that the sum of A and B (or b) variations with maxima near the equinoxes coincides for h_{max} with the annual temperature variations and for f_0 probably with the variations of $[O]/[N_2]$ of the neutral atmosphere. The behavior of S_{f_0, h_{max}, y_m} at low latitudes can be easily interpreted proceeding from the effect of horizontal winds on the ionosphere. However, explanation of anomalous and considerable out-of-phase variations of S_{f_0} and $S_{h_{max}}$ at middle latitudes requires additional mechanisms. (auth)

25112 EFFECT OF COLLISIONS ON ION-ACOUSTIC WAVES IN THE TOPSIDE IONOSPHERE. Zhmur, L. E. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 699-702(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 825-828(1973).

The effect of collisions on ion-acoustic waves excited in the topside ionosphere during geomagnetic disturbances is investigated. It is demonstrated that the main role is played by the collisions of ions with neutral particles, described by frequencies ν_{in}. The reflection and transmission coefficients of ion-acoustic waves are determined. (auth)

25113 ANISOTROPY OF VLF ABSORPTION IN THE POLAR IONOSPHERE. Leonov, V. I. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 715-719(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 844-849(1973).

The average diurnal pattern of the strength of the VLF field on polar paths is explained by the manifestation in VLF absorption of the auroral oval in the premidnight sector and of the region of additional ionization in the auroral zone in the morning sector. The variations in the height of the polar part of the waveguide are estimated. (auth)

25114 PROPAGATION OF MHD WAVES ALONG THE LOWER BOUNDARY OF THE IONOSPHERE. Sorokin, V. M.; Fedorovich, G. V. Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 732-736(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 866-870(1973).

The excitation and propagation of a magnetohydrodynamic pulse along the plane interface of a nonconducting medium and a magnetized plasma are investigated. MHD waves are excited by the field of a magnetic dipole located at the interface of the two media. (auth)

25115 IONOSPHERIC EFFECTS OF GEOMAGNETIC STORMS AT MIDDLE LATITUDES. Khocholava, G. M.; Kadukhin, G. F.; Mebagishvili, N. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 743-745(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 878-881(1973).

The ionospheric effects of the large geomagnetic storm of October 26 to 31, 1968, are investigated. N(h) profiles are constructed for the active storm period and the geomagnetically quiet day of October 22, 1968. The total integral electron density from h = 200 km to the height of the F-region maximum is computed. The values of the recombination coefficient β (h, t) are found from the continuity equation and compared with the β (h, t) values determined from a theoretical model. (auth)

25116 RATES OF IONIZATION OF THE ATMOSPHERE BY SOLAR RADIATION. Krasnopol'skii, V. A. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 746-749(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 882-886(1973).

The rates of ionization of the atmosphere are computed for two atmospheric models with different $Z_\odot$. The method of computation is refined for $\lambda < 300$ A, where multiple ionization effects are significant, and the role of excited ions is examined. (auth)

25117 SOME PROBLEMS CONCERNING THE INTERACTION BETWEEN RADIATION AND MATTER. Velinov, P. Izv. Geofiz. Inst., Bulg. Akad. Nauk.; 19: 105-140(1974). (In Russian).

The problem of interaction between radiation (wave and corpuscular and matter is considered. At the beginning, an analogy is made between the effects of the corpuscular and electromagnetic radiation on the atmospheres of planets. On the basis of this analogy a general expression for the ionization by both types of radiation is given. After varying this expression an equation for the variation of the rate of electron production by cosmic rays and electromagnetic radiation applied to the ionosphere is obtained. A unified classification is given of the variations which are grouped into three classes: meteorological, geomagnetic (missing in the wave radiation), and variations of the primary flux of ionizing radiation. Some aspects of the effect of cosmic rays in the ionospheres of planets and the defense from cosmic rays and the internal radiation belt in space flights are considered. Finally, a general solution of the problem of matter ionization under the influence of charged particles with energy and spatial distribution is presented. (5 figures, 5 tables) (auth)

25118 PROTON PRECIPITATION DURING THE AURORAL BREAKUP. Belon, A. E.; Romick, G. J.; Stringer, W. J. (Univ. of Alaska, College). Planet. Space Sci.; 22: No. 5, 735-742(May 1974).

Rapid measurements of the spatial and temporal variations of the Balmer beta line of hydrogen in aurorae have been obtained with a meridian-scanning photometer. The data confirm previous spectrographic evidence which shows that the pre-breakup "hydrogen arc" is a stable, weak and diffuse arc of considerable latitudinal extent. This description is consistent with theoretical calculations for the precipitation pattern of low-energy isotropic protons. The photometric data also reveal that the hydrogen emissions participate in the auroral breakup. At that time the H-beta line increases markedly in intensity, becomes spatially discrete, and appears within the bright breakup arc. Such behavior implies an increase in the proton flux and either a large increase in the energy of the incident protons or a drastic narrowing of their pitch angle distribution. Both effects may occur, but the present data does not provide specific information on pitch angle distributions. On the other hand, the observational evidence from the concurrent behavior of the other auroral emissions and from other types of measurements indicates that the characteristic energy of the incident protons increases from approx 15 keV to 150 keV during the breakup phase of an auroral display. The possibility of electron excitation of ambient hydrogen has been re-examined. Taking extreme values for the electron flux, H-beta excitation cross-section and atmospheric hydrogen density, it is possible that up to 40% of the hydrogen emission observed in bright, discrete breakup arcs can be attributed to electron excitation of ambient hydrogen. However, there is insufficient data at this time to determine whether or not this mechanism is actually contributing significantly to the observed hydrogen intensity. (auth)

25119 SOLAR-TERRESTRIAL DISTURBANCES OF AUGUST 1972. XVI. Observations of the D-Region During SID's by LF Radio Wave Over Short Path. Takenoshita, Y.; Takeuchi, T.;

Echizenya, Y. (Radio Research Lab., Koganei, Japan). Denpa Kenkyusho Kiho; 19: No. 103, 373-378(Jul 1973). (In Japanese).

Observations of D-region during SID's by means of measurements about phase and intensity of LF radio wave (40 kHz) propagating over distance of 456 km were carried out. Two major SID's occurred at 0315 UT, on August 2 and 0623 UT, on August 4, 1972. During the former SID, the phase height of LF radio wave descended by 5.5-6.2 km at the maximum phase of the solar flare and the reflection coefficient got down from -5dB sharply to -15.5dB with rapid recovery in the expanding period of the solar flare. The reflection coefficient again got down slowly in the recovery phase. During the latter SID, the phase height descendence reached 6.2-7.0 km and the reflection coefficient got down from -4dB to -8dB. It was suggested that the reflection coefficient descendence was attributed to a height distribution of electron density the declination of which became gradual through D-region during expanding and recovery phases of a solar flare. (auth)

25120 SOLAR-TERRESTRIAL DISTURBANCES OF AUGUST 1972. VI. Riometer Observation at Syowa Station. Ose, M.; Isozaki, S.; Miyazaki, S. (Radio Research Lab., Koganei, Japan). Denpa Kenkyusho Kiho; 19: No. 103, 292-295(Jul 1973). (In Japanese).

The observational results of the ionospheric absorption by riometer during August, 1972 at Syowa Station in Antarctica are presented and a brief discussion is given on the ionospheric absorption by polar cap disturbances and auroral zone disturbances with other data. (auth)

25121 SUNSPOT CONTROL OF IONOSPHERIC ABSORPTION. Lastovicka, J. (Geophysical Inst., Prague). Geofiz. Sb.; 17: 291-298(1969).

An evaluation is presented of ionospheric absorption measurements taken at Pruhonice at 272 kHz. It was found that no repeating variations actually existed of the effect of sunspot activity on ionospheric absorption at sunset and sunrise. The repeating variations of absorption and the dependence of absorption on the number of sunspots are more evident at sunset than at sunrise. No correlation was found between the number of sunspots and ionospheric absorption. Other factors, at least partly independent of sunspot activity, considerably affect the ionospheric absorption. (Nuclear Sci. Abstr. Czech.)

25122 ROCKET OBSERVATION OF TWILIGHT AIRGLOW IN THE NEAR INFRARED REGION. Hayakawa, S.; Ito, K.; Matsumoto, T.; Nishimura, T. (Nagoya Univ., Japan). J. Geomagnet. Geoelec.; 25: No. 3, 281-296(1973).

Twilight airglow emissions in the wavelength ranges at about 1.3 μm, 1.7 μm and 2.2 μm were observed by a rocket-borne photometer. The heights of the airglow layers and the local times at emission regions were derived taking into account the roll, precession and altitude of the rocket. The volume emission rates in these three bands were peaked at about 73 km. The mean lifetime of the $O_2(^1\Delta g)$ molecules was obtained to be 33 ± 2 minutes from the time variation of the airglow intensity in the 1.3 μm band. This is accounted for in terms of a combination of the spontaneous decay and the collisional de-excitation. The rate constant for the latter is about half of that obtained in laboratory measurements at room temperature. (auth)

25123 STUDY OF SUDDEN COSMIC NOISE ABSORPTION IN RELATION TO CORRESPONDING X-RAY FLARES. Sain, M. (All India Radio, Jaipur); Rao, U. K. J. Inst. Telecommun. Eng.; 17: No. 9, 347-353(Sep 1971).

An exhaustive study of x-ray flare which occurred on 13 April 1966 between 0706 UT has been made. Raw data for this x-ray flare have been converted to the flux energy in erg cm^{-2} sec^{-1} and the corresponding time curves have been plotted. N-h profiles for the D-region for values of 30°, 50° and 60° have been worked out at the maximum of the flare. N-h profiles for the values of 50° and 60° correspond respectively to Manila and Ondrejov. The SCNA data for Manila on 18 Mc/s and for Ondrejov on 29 Mc/s have been employed to work out a model of effective recombination coefficient (α_{eff}). The height of maximum electron density comes to about 72 km and the corresponding maximum of absorption is found to occur at about 68 km. This is in agreement with the results of Mitra et al. (1966). (auth)

25124 BASIC CHARACTERISTICS OF THE WHISTLING ATMOSPHERICS OBSERVED IN SOFIA. Raichovski, Tz. Izv. Geofiz. Inst., Bulg. Akad. Nauk.; 19: 141-147(1974). (In Bulgarian).

The basic parameters of the phenomenon "whistling atmospherics" which were recorded in Sofia after July 1970 are considered. The station with a geographical dipole latitude $\varphi = 42.7°$ is neither a typical middle-latitude one nor a low-latitude one. "Ordinary" whistlers as well as whistlers with extremely low dispersions, 15 $s^{\frac{1}{2}}$, were recorded in it. The processed material from the observations for the period August 1970-August 1971 allowed investigation of the diurnal and seasonal variations of the whistler's activity, the causes for them, and the time of maximum whistler occurrence. The whistlers analyzed are short, one-hop type. The results show a maximum of whistler activity during the night hours of the local winter and an absolute minimum (lack of whistlers) around noon and during the whole day of August. From the dispersion investigation of the whistling atmospherics, it is established that during the whole year and the whole day the dispersions remain approximately within the interval 40 to 70 $s^{\frac{1}{2}}$. This interval may be considered a typical one for the station. When long two-hop-type whistlers are available, their dispersion does not surpass 105 $s^{\frac{1}{2}}$. No information can be given about the nose whistlers and echo, as they were not observed during the period under observation. (2 figures, 1 table) (auth)

25125 CHARACTERISTICS OF THE IONOSPHERIC TROUGH IN THE AFTERNOON ACCORDING TO GROUND-BASED VERTICAL SOUNDING DATA. Besprozvannaya, A. S. (Arctic and Antarctic Inst., Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 793-795(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 935-936(1973).

An analysis of ground-based sounding data showed that in the afternoon sector the density gradient is much higher on the low latitude wall of the ionospheric trough. It is suggested that the sharp low latitude wall characteristic may be related to the effect of decoupling of the plasma from the plasmasphere as the electric field of convection during magnetically disturbed periods increases. (JFP)

25126 TRAVELING DISTURBANCES IN MAGNETICALLY CONJUGATE REGIONS OF THE IONOSPHERE. Sheftel, V. M.; Chernysheva, S. P. (Rostov-on-Don State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 795-796(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 937(1973).

The phenomenon of conjugation of traveling disturbances in the ionosphere and regularity of appearance of E_s layers during their passage were studied on the basis of data of the conjugate stations. Ionograms of ten regular international days for March, June, and September 1965 were used. (JFP)

25127 PLASMA RESONANCE IN THE IONOSPHERE. Shvartsburg, A. B. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 784-786(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 925-926(1973).

For a specific model of the ionosphere, the interval of frequencies that may excite plasma resonance in the ionosphere is defined. Also the length of a plasma wave as a function of resonance detuning and of the distribution of the directions of plasma waves is studied. (JFP)

25128 IONIZING SOLAR RADIATION ACCORDING TO KOSMOS 381 DATA AND ITS EFFECT ON THE IONOSPHERE. Avakyan, V. S.; Bolgartseva, M. P.; Gershun, L. N.; Efremov, A. I.; Kushnerevskii, Yu. V.; Leshchenko, L. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 781-783(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 922-924(1973).

Some preliminary results are reported on the intensity of solar radiation during the flight of Kosmos 381 and on the effect of this radiation on the earth's ionosphere. (JFP)

25129 RELATIONSHIP BETWEEN THE SECTOR STRUCTURE OF THE INTERPLANETARY MAGNETIC FIELD AND AURORAL ACTIVITY. Starkov, G. V.; Fel'dshteyn, Y. I.; Shevnina, N. F. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 807-809(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 949-950(1973).

The correlation between temperature in the surface region of the atmosphere and the critical frequency of the F_2 layer of the ionosphere was studied. Since the critical frequency f_0F_2 has a normal 24-hour pattern and there is interest in changes in the type of disturbances, the deviations of f_0 from its median value were examined. (JFP)

25130 DIURNAL VARIATIONS IN ELECTRON DENSITY DISTRIBUTION OF THE QUIET IONOSPHERE AT MIDDLE LATITUDES. Soboleva, T. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 790-793(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 932-934(1973).

On the basis of a generalization of experimental results of a

study of the ionosphere by various methods, N(h) profiles of middle latitudes at heights h = 50 to 1000 km at 2-hour intervals were plotted. The results of measurements on geomagnetically quiet days ($K_p < 2$) of the equinoctial periods of 1963 to 1965 were used obtained at neighboring points. Model N_e (h) profiles plotted in the indicated manner at two-hour intervals and diurnal variations of the heights of the maxima and minima of the base and intermediate layers are shown. (JFP)

25131 NOMOGRAMS FOR CALCULATING A MODEL N(h) PROFILE IN THE D REGION OF THE IONOSPHERE. Danilkin, N. P.; Denisenko, P. F. (Roston-on-Don State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 786-788 (1973).

Translated from Geomagn. Aeron.; 13: No. 5, 927-928(1973).

Grid nomograms calculated by a previous method which on the basis of experimental values of h'' and L obtained at middle latitudes, permit the determination of parameters N_{s0}, α, and β without machine computation. From these parameters, the determination of the entire N(h) profile may be made. (JFP)

25132 CHANGES IN THE DISTRIBUTION OF N_e IN THE PRESENCE OF A VERTICALLY TRAVELING DISTURBANCE IN THE F REGION. Vasil'ev, K. N.; Freyzon, A. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 788-790(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 929-931(1973).

The influence of vertically traveling disturbances on the distribution of ionization with height and the behavior of dN/dh gradients at various levels of the F region is analyzed. For this purpose calculations of N(h) profiles were made during the appearance of the vertically traveling disturbances on the ionograms. (JFP)

25133 CHARACTERISTICS OF THE IONOSPHERE AND STRATOSPHERE DURING THE WINTER. Chavdarov, S. S.; Ryss, I. K.; Chernysheva, S. P.; Boldyrev, N. M. (Rostov-on-Don State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 799-801(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 940-941(1973).

A description is given of the ionosphere and stratosphere during winter. To establish the relation between radiowave absorption in the ionosphere and stratospheric heating, use was made of daytime temperatures at constant pressure levels from 5 to 50 mb, obtained by the Rostov aerological station during the winter months of 1964 to 1971, and ionospheric measurements made in Rostov during the same period. (JFP)

25134 THREE-DIMENSIONAL CURRENT SYSTEM OF A SUBSTORM ALLOWING FOR THE MUTUAL INFLUENCE OF MAGNETICALLY CONJUGATED REGIONS OF THE IONOSPHERE. Van'yan, L. L.; Debabov, A. S. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 810-811(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 951-952(1973).

It is found that the inhomogeneity of a gyrotropic ionosphere leads to the induction of longitudinal currents of type II, characterized by a much smaller magnetic disturbance than the system of type I. It is noted that as a result of polarization of the boundaries of the disturbance zone, the electric field of the current system of type I is closer to meridional than the electric field of type II. (JFP)

25135 TWILIGHT VARIATION OF THE AIRGLOW. I. [01] 6300 A Radiation. Misawa, K. (Defense Academy, Yokosuka, Japan). Rep. Ionosphere Space Res. Jap.; 27: No. 3, 85-90(Sep 1973).

Zenith records of [01] 6300 Å airglow intensities have been obtained at Yokosuka (geomagnetic lat. + 25.0°, long. 205.7°; geographic lat. 30°15′, long. 139°44′) from November 1972 to June 1973. The intensity variations at zenith were recorded every minute. The use of a photometer with a refrigerator for photomultiplier resulted in reliable and accurate data of the airglow intensity. Distinct inflection points of the intensity enhancement were found, which suggested the twilight activity of the red line emission. (auth)

25136 EFFECT OF GEOMAGNETIC DISTURBANCES ON THE MIDLATITUDE NIGHTTIME E REGION. Korsunova, L. P. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 708-711(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 835-839(1973).

From a comparison of electron density variations at fixed heights in magnetically quiet and disturbed periods at night it is found that n_e increases by a factor of 3 to 5 at h > 110 km when $K_p > 5$. The observed increase in electron density is produced by additional ionization at these heights during disturbances. The contribution of the additional source and its variation from day to night are estimated. (auth)

25137 MESOSPHERIC POSITIVE ION CONCENTRATIONS, MOBILITIES, AND LOSS RATES OBTAINED FROM ROCKET-BORNE GERDIEN CONDENSER MEASUREMENTS. Conley, T. D. (Air Force Cambridge Research Labs., Bedford, MA). Radio Sci.; 9: No. 6, 575-592(Jun 1974).

The theory and operation of a Gerdien condenser in a collision-controlled regime is reviewed. Its operation under supersonic flow conditions is then presented and the results of calibration of the instrument in a wind tunnel are discussed. The theory of mobility is reviewed and the importance of a mean-free-path or mean-free-time model between ion-neutral collisions is discussed. Experimental positive ion mobility data are presented and compared with the data of Rose and Widdel [1972] and the extrapolated values of small ion laboratory results. The assumption of chemically frozen flow is then considered concerning the equilibrium distribution of the water cluster ions and their temperature-dependent decomposition rates. It is shown for flow at Mach 3 that when the shock is detached the dominant cluster ions are not frozen. However, when the shock is swallowed the $H^+(H_2O)_3$ ion is frozen at all altitudes above 40 km and the $H^+(H_2O)_4$ ion is frozen about 65 km. The predicted mobility of the dominant positive ions, i.e., $H^+(H_2O)_3$ and $H^+(H_2O)_4$, based on a mobility dispersion curve for nitrogen, is compared with experimental data. Positive ion density data are presented for four rocket flights during a PCA and one flight during an auroral absorption event. Finally, positive ion loss rates are shown based on the positive ion measurements and proton flux data obtained from rockets and satellites. (auth)

25138 IONIZATION BALANCE IN THE D REGION. Ganguly, S. (University Coll. of Tech., Calcutta). J. Geophys. Res.; 79: No. 1, 267-270(1 Jan 1974).

Attempts have been made to compare the mesospheric electron density values derived from multifrequency radio wave absorption data for a low-latitude station with the ionization production rates of O_2^+ and NO^+ under different conditions of solar zenith angles and solar activity levels. For both 80 km and 90 km the relation $q \propto N$ is found to be a better approximation than the simple recombination type of relation $q \propto N^2$. In addition, the situation at 80 km appears to be more complicated and indicates the possibility of a lower NO density than that implied in the observation by Meira (1971). (auth)

25139 EVOLUTION WITH SOLAR ACTIVITY OF THE ATOMIC HYDROGEN DENSITY AT 100 KILOMETERS OF ALTITUDE. Vidal-Madjar, A. (Centre National la Recherche Scientifique, Verrieres-le-Buisson, France); Blamont, J. E.; Phissamay, B. J. Geophys. Res.; 79: No. 1, 233-241(1 Jan 1974).

An important point of the Vidal−Madjar et al. (1973) paper is clarified. In fact, some of the results presented in that paper are sensitive to the choice of the exospheric temperature. Because Vidal−Madjar et al. used a rough estimation of that parameter, neglecting the geomagnetic heating, systematic differences appeared in their results. The use of a more precise representation of the exospheric temperature here allows us to present in particular a better evaluation of the atomic hydrogen density evolution at 100-km altitude. This density variation seems to be rather large and at least a factor of 3 between 2×10^7 and 6×10^7 atoms cm^{-3}. Furthermore, all the densities of atomic hydrogen at 500-km altitude, recalculated with the use of a better representation of the exospheric temperature parameter, are listed here for 3 consecutive years (1969, 1970, and 1971). (auth)

25140 OBSERVATIONS OF THE EXTREME ULTRAVIOLET NIGHTGLOW. Riegler, G. R. (Bendix Aerospace Systems Division, Ann Arbor, MI); Garmire, G. P. J. Geophys. Res.; 79: No. 1, 226-232(1 Jan 1974).

An extreme ultraviolet telescope system was flown on an Aerobee 170 rocket from the White Sands Missile Range on October 22, 1971. Measurements of extreme ultraviolet radiation from the night sky were made with a set of Parylene, aluminum, and tin filters behind a grazing incidence concentrator. If the aluminum and tin filter data are interpreted as being due to only the He I 584-Å and He II 304-Å lines, the nightglow flux at 25° zenith angle and 270° azimuth angle at 180-km altitude was I(584) = 4.4 ± 1.9 R and I(304) = 1.3 ± 0.5 R. (auth)

25141 EMPIRICAL MODEL OF GLOBAL THERMOSPHERIC TEMPERATURE AND COMPOSITION BASED ON DATA FROM THE OGO 6 QUADRUPOLE MASS SPECTROMETER. Hedin, A. E. (Goddard Space Flight Center, Greenbelt, MD); Mayr, H. G.; Reber, C. A.; Spencer, N. W.; Carignan, G. R. J. Geophys. Res.; 79: No. 1, 215-225(1 Jan 1974).

An empirical global model for magnetically quiet conditions has been derived from longitudinally averaged N_2, O, and He densities

by means of an expansion in spherical harmonics. The data were obtained by the Ogo 6 neutral mass spectrometer and cover the altitude range 400–600 km for the period June 17, 1969, to May 13, 1971. The accuracy of the analytical description is of the order of the experimental error for He and O and about 3 times the experimental error for N_2 and thus provides a reasonable overall representation of the satellite observations. Two model schemes are used: one representing densities extrapolated to 450 km and one representing densities extrapolated to 120 km with exospheric temperatures inferred from N_2 densities. Features in the thermospheric structure brought out by the model include a near 1000 hour local time maximum for He and a 1600 hour maximum for N_2 at 450 km, a winter maximum in the O to N_2 ratio at 120 km, and a 400°K summer to winter exospheric temperature difference with the diurnal temperature bulge located at high latitudes in summer. (auth)

25142 OCCURRENCE AND VERTICAL MOVEMENT OF KINK AT KODAIKANAL. Iyer, K. N.; Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). J. Geophys. Res.; 79: No. 1, 209-214(1 Jan 1974).

The occurrence of ionospheric irregularities observed as sharp discontinuities (kinks) on the ionograms and moving upward with time at Kodaikanal have been studied for a period covering high, medium, and low solar activity conditions. These kinks are most common during the summer season and during the morning (0900 LT) and the evening (1500 LT). The vertical velocities of these irregularities obtained by true height analysis of the ionograms lie in the range 10–40 m/s. The velocity shows a minimum around noon with no significant solar cycle dependence. One of the possible causes for the generation of these irregularities is suggested to be the accumulation of metallic ions over the equator by equatorward neutral winds or gravity waves, and their uplift is suggested to be due to the E × B drift. (auth)

25143 ATMOSPHERIC GRAVITY WAVES INDUCED BY EARTH'S DIURNAL ROTATION. Datta, R. N. (University Coll. of Science and Tech., Calcutta). J. Geophys. Res.; 79: No. 10, 1583-1584(1 Apr 1974).

Tentative arguments are drawn to suggest that portions of the earth's lower atmosphere in the course of the earth's diurnal rotation could behave in a manner analogous to the fast moving cooling spot of the lunar shadow during a solar eclipse and thereby could induce atmospheric gravity waves in that region. The implications of this phenomenon are qualitatively explored for describing some features of TID's and sporadic E in the ionosphere as have been reported elsewhere. (auth)

25144 TWILIGHT AIRGLOW. II. N_2^+ EMISSION AT 3914 A. Sharp, W. E. (Univ. of Michigan, Ann Arbor). J. Geophys. Res.; 79: No. 10, 1569-1571(1 Apr 1974).

One of the experiments aboard a rocket flight carrying instruments to measure the dawn airglow, the ion and electron densities, and the photoelectron spectrum is reported. For a solar zenith angle of 90° the emission at 3914 Å from N_2^+ peaks at about 260 km. The integrated intensity from model calculations suggests that resonance scattering of 3914-Å solar photons off N_2^+ produces 90% of the emission, whereas simultaneous photoionization excitation of N_2^+ produces less than 10% of the emission. Photoelectron impact excitation is found to contribute about 1%. (auth)

25145 WAVELENGTH DEPENDENCE OF RADIO SCINTILLATION: IONOSPHERE AND INTERPLANETARY IRREGULARITIES. Rufenach, C. L. (National Oceanic and Atmospheric Administration, Boulder, CO). J. Geophys. Res.; 79: No. 10, 1562-1566 (1 Apr 1974).

Recent in situ measurements and scintillation spectra suggest a power law irregularity spectrum in the F region ionosphere with a large outer-scale dimension (~100 km). This result is consistent with the "near-field" scintillation approximation, since Fresnel filtering attenuates irregularity structure larger than $(\pi\lambda z)^{\frac{1}{2}}$, about 1 km. Consequently, the observed scintillation scale (~1 km) is much smaller than the outer-scale dimension of the irregularities. Theoretical calculations show that Gaussian irregularities cannot explain these differences in scale. The wavelength dependence based on small scintillation levels has most often been reported as approximately λ^1 and λ^2 for interplanetary and ionospheric scintillation, respectively. Differences between these measurements and the theoretical dependence are discussed. (auth)

Magnetospheric Phenomena

25146 (N-71-35437) COORDINATED SATELLITE AND INCOHERENT SCATTER OBSERVATIONS. Progress Report. Woodman, R. F.; Lagos, C. P. (Instituto Geofisico, Lima (Peru)). Aug 1971. 74p. (NASA-CR-121984). NTIS.

Four types of information are presented: electron density and temperature profiles collected at the Jicamarca Radar Observatory, Lima, Peru, located near the magnetic equator, coincident with twenty near-overhead passes of OGO-6; films of spread-F structure coincident with seven near-overhead passes of OGO-6; electron density contours and vertical plasma drifts coincident with five 6300 A nightglow emission intensities measured at the Huancayo Observatory; and references to papers completed and prepared for publication which are connected with nightglow studies and special events such as a magnetic storm and a solar eclipse. (auth)

25147 (N-73-18389) ATMOSPHERIC EFFECTS ON RADIATION MEASUREMENTS. Jurica, G. M. (Purdue Univ., Lafayette, Ind. (USA)). 1973. 26p. (NASA-CR-130828; LARS-11573). NTIS $3.50.

Two essentially distinct regions of the electromagnetic spectrum are discussed: the scattering region in which the radiation energy is provided by the incident solar flux; and the infrared region in which emission by the earth's surface and atmospheric gases supply radiative energy. In each of these spectral regions the atmosphere performs its dual function with respect to a remote sensing measurement of surface properties. The atmosphere acts both as a filter and as a noise generator removing and obscuring sought after information. Nevertheless, with proper application of concepts such as have been considered, it will be possible to remove these unwanted atmospheric effects and to improve identification techniques being developed. (auth)

25148 THERMAL AND SUPRATHERMAL PLASMA DENSITIES IN THE OUTER MAGNETOSPHERE. Gurnett, D.A.; Frank, L.A. (Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa 52242). J. Geophys. Res. 79: No. 16, 2355-2362 (1 June 1974).

By using the low-frequency cutoff of electromagnetic noise trapped in the magentosphere at frequencies above the local plasma frequency it is now possible to make very accurate, ±1%, electron density measurements in the low density region between the magnetopause and plasmapause. This technique for measuring the total plasma density has been used, together with measurements of the suprathermal proton intensities with the Lepedea instrumentation on the Imp 6 spacecraft, to determine the thermal proton densities in the region between the plasmapause and magnetopause. Although the thermal protons usually account for a significant fraction, ~50%, of the total proton density in this region, in some cases, particularly at the larger radial distances, the density of the thermal protons sometimes drops to a very small fraction, <5%, of the total density, and nearly all of the plasma consists of suprathermal particles. Usually, the high-energy tail of the thermal proton distribution is sufficiently intense to be detected at low energies within the Lepedea energy range. When the high-energy tail of the thermal distribution can be detected, it is possible to determine the temperature of the thermal protons. The temperature in a typical case is found to be 80,000°K. This high temperature for the thermal protons, which are presumably of ionospheric origin, agrees with earlier Ogo 5 measurements reported by Serbu and Maier. (auth)

25149 STORM TIME Pc 5 MAGNETIC PULSATION AT THE EQUATOR IN THE MAGNETOSPHERE AND ITS LATITUDE DEPENDENCE AS MEASURED ON THE GROUND. Lanzerotti, L.J.; Fukunishi, H. (Bell Laboratories, Murray Hill, New Jersey 07974); Lin, C.C.; Cahill, L.J. J. Geophys. Res. 79: No. 16, 2420-2426 (1 June 1974).

A discussion is presented of a Pc 5 magnetic pulsation event observed at L~5.5 at the equator in the magnetosphere and at four ground stations in the vicinity of the foot of the field line through the satellite. A large degree of similarity is observed in the field variations in the azimuthal (E-W) component at all locations. The wave in the transverse plane at the satellite is right-handed polarized, whereas at the ground stations it is observed to be left-handed polarized at all latitudes. All of the observations are consistent with a model of a wave source with a narrow localization between L~4.5 and L~5.0 in the latitudinal direction and along azimuthal wavelength. Hot plasma particle measurements made on the satellite during the time of the event suggest that the excitation of the drift mirror instability may produce the hydromagnetic wave. (auth)

25150 OUTLINE OF A MAGNETOSPHERIC THEORY. Heikkila, W.J. (University of Texas at Dallas, Dallas, Texas 75230). J. Geophys. Res. 79: No. 16, 2496-2500 (1 June 1974).

Magnetospheric and auroral energy dissipation can be described in terms of electric fields and currents. We suggest that the energy is created by an MHD generator in front of the magnetopause that derives its energy from the slowing down of the solar wind plasma. It drives a westward current in front of the eastward magnetopause surface current. The action of this generator is to produce and maintain the charge

polarization that creates the dawn–to–dusk magnetospheric electric field. Various auroral phenomena are direct consequences of this electrostatic field. The source of auroral particles is magnetosheath plasma that enters the magnetotail by diffusion (violating Liouville's theorem) across the sharp boundaries of the cleft. A continuous auroral oval is the trace of the subsequent energization and precipitation. A small parallel component is responsible for auroras in the morning and evening sectors of the oval. However, the most important steady state energization processes are due to the transverse electric field in the plasma sheet associated with curvature and gradient drifts. The result is two kinds of auroras, high–latitude arcs and lower-latitude diffuse bands, due to these two processes. The slow buildup in energy density leads to the escape of the energized plasma away from the earth. This escape disrupts the steady state equilibrium and initiates the expansive phase of a substorm. Both transverse and transient parallel electric fields play important roles in the subsequent evolution of the substorm. (auth)

25151 PLASMASPHERIC HISS INTENSITY VARIATIONS DURING MAGNETIC STORMS. Smith, E.J.; Frandsen, A.M.A.; Tsurutani, B.T. (Jet Propulsion Laboratory, Pasadena, California 91103); Thorne, R.M.; Chan, K.W. J. Geophys. Res. 79: No. 16, 2507-2510 (1 June 1974).

The storm time intensity variations of ELF electromagnetic emissions have been studied by using the Ogo 6 search coil magnetometer. Low-latitude signals exhibit a sharp low-frequency cutoff and are identified as plasmaspheric hiss. Such waves show pronounced intensification during the recovery phase of magnetic storms but remain close to background levels during the storm main phase. This behavior is consistent with cyclotron resonant generation within the plasmasphere as the latter expands into the intensified belt of outer zone electrons during the storm recovery. (auth)

25152 PLASMAPAUSE CROSSING DETERMINED BY USING THE OBLIQUE PLASMA RESONANCE EXCITED BY A SATELLITE–BORNE RF ANTENNA. Koons, H.C. (Laboratory Operations, The Aerospace Corporation, El Segundo, California 90245). J. Geophys. Res. 79: No. 16, 2526-2528 (1 June 1974).

The location of the plasmapause has been measured by an oblique plasma resonance technique. The angle with respect to the geomagnetic field at which this resonance occurs is sensitive to the ambient electron density. During magnetically quiet conditions, abrupt changes in this angle, implying a steep electron density gradient, occur between $L=3.2$ and $L=3.6$ between 0400 and 0500 LT. This location agrees with the expected location of the plasmapause at that time as measured by the whistler dispersion technique. (auth)

25153 MAPPING THE LOCAL TIME–UNIVERSAL TIME DEVELOPEMENT OF MAGNETOSPHERIC SUBSTORMS USING MID–LATITUDE MAGNETIC OBSERVATIONS. Clauer, C.R.; McPherron, R.L. (Department of Planetary and Space Science and Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California 90024). J. Geophys. Res. 79: No. 19, 2811-2820 (1 July 1974).

Contour maps of mid–latitude geomagnetic perturbations of both north–south and east–west field components have been created to study the variability of magnetospheric substorm development. The maps were obtained by substracting quiet day variations from observations along a longitudinal chain of observatories; this procedure created smooth interpolations of the resulting local time profiles at equal increments of universal time. The results were then contoured in the local time–universal time plane. To isolate magnetic perturbations during substorm expansions, 'normalized' maps were created by first subtracting the local time profile at the onset of the expansion from all later profiles. Examples of substorm variability have been chosen to demonstrate multiple onsets and movement of bay activity either eastward or westward from the meridian of initial onset. The local time profile obtained from the normalized map at the peak of the expansion represents the mid–latitude effects of the final substorm current systems. These profiles match the magnetic effects of a simple model in which a portion of the tail current is diverted through the auroral ionosphere via field lines. These profiles are further used to compute substorm parameters that include the meridian of onset, the meridian of maximum bay development, the magnitude, and extent of the event. Such quantification allows for better description of substorm features than has previously been available. (auth)

25154 A THEORY OF THE SUBSTORM MECHANISM. Schindler, K. (Ruhr-Universitat Bochum, Germany). J. Geophys. Res. 79: No. 19, 2803-2810 (1 July 1974).

By using the self-consistent stability theory it is shown that during the growth of a magnetospheric substorm the stability of the tail configuration decreases. Taking two–dimensionality into account explicity, we show that the free energy built up during the growth phase can be released when the plasma sheet has become sufficiently thin and/or the normal magnetic field component has been sufficiently reduced. Then the ion–tearing mode will abruptly set in and lead to changes in the magnetic field topology. It is speculated that there is a tendency for a macroscopic neutral line to form fairly close to the earth. Lack of equilibrium will lead to energy dissipation and enhanced precipitation. (auth)

25155 GEOMAGNETIC PULSATIONS AND INTERPLANETARY MAGNETIC FIELD. Bossolasco, M.; Elena, A. Riv. Ital. Geofis.; 22: 144-146(1973).

From second general assembly of the Association of Geomagnetism and Aeronomy; Kyoto, Japan (12 Sep 1973).

Investigation of a possible relationship between the interplanetary magnetic sector structure and the corresponding behavior of the geomagnetic pc micropulsations. Using recordings of geomagnetic micropulsations obtained at a station in Northern Italy during the IQSY, it is found that the activity of pc 2, 3, and 4 becomes maximum when the earth crosses the boundary between a sector of the interplanetary magnetic field with positive polarity and one with negative polarity. Only pc 4 clearly show a similar behavior in the case where the earth passes from a sector with negative polarity to one with positive polarity. An attempt is made to explain these results. (IAA)

25156 SUPRATHERMAL ELECTRONS NEAR THE LOWER EDGE OF THE RADIATION BELT. Hayakawa, S.; Kato, T.; Kohno, T.; Murakami, T.; Nagase, F. (Nagoya Univ., Japan). J. Geomagnet. Geoelec.; 25: No. 2, 113-129(1973).

Suprathermal electrons of energies between 5 keV and 10 keV were found to exist in the altitude range 200 to 800 km at geomagnetic latitude 20°N, the L-value ranging from 1.17 to 1.25. The electrons were detected with proportional counters of thin plastic windows on board a sounding rocket L-3H-7 launched at 21:00 Japanese Standard Time on September 3, 1971, when solar and geomagnetic activities were quiescent. The angular distribution of the electrons was peaked in the direction perpendicular to the magnetic line of force at altitudes above 500 km, indicating that the electrons are trapped in the geomagnetic field. The altitude dependence is in essential agreement with that expected from the collision loss of electrons in the upper atmosphere. The extrapolation of the measured altitude dependence to the radiation belt gives an electron flux much lower than that observed inside the belt. (auth)

25157 ROCKET OBSERVATION OF SUPRATHERMAL ELECTRONS IN THE ENERGY RANGE 6.5-23 keV AT MIDLATITUDE. Kohno, T. (Nagoya Univ., Japan). J. Geomagnet. Geoelec.; 25: No. 2, 131-144(1973).

Electrons of energies between 6.5 and 23 keV have been observed from a sounding rocket with a thin-window (37 $\mu g/cm^2$ polypropylene) proportional counter in the altitude range between 140 km and 326 km at the geomagnetic latitude of 20°N, the L-value at the apogee being 1.17. The directional dependence of the electron flux with respect to the magnetic line of force indicates that these electrons consist of two components, the one peaked perpendicular to the line of force and the other being isotropic in the upper hemisphere. The former is considered to be geomagnetically trapped and the latter to be precipitating along the line of force. The flux ratio of the trapped to the isotropic components is 0.77 ± 0.12 and 1.7 ± 0.2 at 200 km and 300 km, respectively. The isotropic component does not change between these altitudes, while the trapped component increases nearly twice as much. The observed intensities of the trapped and the isotropic electrons at 300 km are (310 ± 20) electrons $\cdot$ $cm^{-2} \cdot sec^{-1} \cdot (4\pi$ sterad$)^{-1}$ and (27 ± 4) electrons $\cdot$ $cm^{-2} \cdot sec^{-1} \cdot$ sterad^{-1}, respectively. (auth)

25158 GEOMAGNETIC ACTIVITY AND THE SOLAR SITUATION IN THE NEIGHBORHOOD OF PROTON EFFECTS. Halenka, J. (Geophysical Inst., Prague). Geofiz. Sb.; 17: 181-202(1969).

The relationship was studied between energetic solar particles and particles causing geomagnetic storms. An analysis of proton effects recorded in 1965 and 1966 outside the magnetosphere does not show a simple relation between the proton effects and the geomagnetic activity; however, an increased geomagnetic activity can be observed in the proximity of powerful proton effects. A coincidence of significant events related to geomagnetically active particles and to energetic particles was observed if conditions were met for both the release of geomagnetically active plasma fluxes and the emission of high-energy protons. It thus appears that the cause of occurrence of geomagnetically effective plasma fluxes is independent of that of the emission of high-energy protons; the plasma fluxes may, nevertheless, represent a specific environment for the transport of energetic particles from the Sun to the Earth. (Nuclear Sci. Abstr. Czech.)

25159 SUDDEN COMMENCEMENT OF GEOMAGNETIC STORMS AT THE TURN OF TWO SOLAR CYCLES. Bednarova-Novakova, B. (Geophysical Inst., Prague). Geofiz. Sb.; 17: 203-224(1969).

For 56 sudden commencements of geomagnetic disturbances

and storms during the years 1962 to 1965, the solar situations on the CM were determined for an interval of 28 to 38 hours prior to a sudden commencement; this is a procedure inverse to that usually applied in geomagnetic activity forecasts. The generation of each sudden commencement was explained using the concept of a sudden creation of individual coronal formations: the central stream, the minimum type corona, and the inclined stream. (Nuclear Sci. Abstr. Czech.).

25160 MOTION OF ALBEDO PARTICLES IN THE GEOMAGNETIC FIELD. Gorchakov, E. V.; Getselev, I. V.; Severinov, V. I. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 779-781(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 920-921(1973).

The trajectories of protons with energies of 200 to 800 MeV or positrons with energies of 644 to 1463 MeV beginning their motion from the injection point, located near the earth's surface were calculated. The geomagnetic field was approximated by a dipole field. The influence of the earth and atmosphere was not considered. (JFP)

25161 TWO-DIMENSIONAL PROBLEM OF THE SHAPE OF THE MAGNETOSPHERE. Obertz, P. Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 758-766(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 896-905(1973).

The two-dimensional problem of the shape of the magnetosphere with a neutral sheet in the tail is solved by conformal mapping for an arbitrary angle of slope of the dipole with respect to the solar wind. The condition for the neutral sheet requires that the absolute value of magnetic field intensity be the same on both sides of it. Numerical computations show that for the parameters of interest under real conditions, the coordinate y of the neutral sheet varies by no more than 10%. As the angle of slope of the dipole increases, the boundary becomes very asymmetric, especially in the neighborhood of neutral points. (auth)

25162 DECAY INTERACTION OF VLF WAVES IN THE EARTH'S MAGNETOSPHERE. Kotik, D. S.; Trakhtengerts, V. Yu. (Gorky Radiophysics Inst., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 737-742(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 871-877(1973).

The decay instability of quasi-monochromatic VLF waves in the earth's magnetosphere is investigated. It is demonstrated that the most effective process is that of the decomposition of the original VLF wave into low frequency plasma and ionacoustic waves and also the parametric interaction of two whistlers and an ionacoustic wave. The instability under consideration can be one of the reasons for the excitation of the lower hybrid resonance, as well as for the amplitude modulation and frequency broadening of quasi-monochromatic VLF signals in the magnetosphere. (auth)

25163 GENERATION OF A DIRECTED HYDROMAGNETIC SIGNAL BY AN ACOUSTIC-WAVE PULSE IN AN ANISOTROPICALLY CONDUCTING MEDIUM. Belov, S. V.; Gorbachev, L. P.; Savchenko, Yu. N. (Moscow Engineering and Physics Inst.). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 693-698(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 818-824(1973).

The generation of a directed hydromagnetic signal produced by an acoustic pulse propagating in the upper atmospheric layers and reaching ionized regions is studied. The range of frequencies $\nu_{ni} \ll \omega \ll \omega_i$, where ν_{ni} is the collision frequency of neutral particles with ions and ω_i is the gyrofrequency of the ions, is investigated. The ionosphere is regarded as a three-component, partly ionized gas consisting of ions, electrons, and neutral particles. (auth)

25164 SOME QUESTIONS OF THE INTERACTION OF SHOCK WAVES OF THE SOLAR WIND WITH THE EARTH'S MAGNETOSPHERE. Grib, S. A. (Int. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 669-673(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 788-793(1973).

The interaction of shock waves with the bow shock and the magnetopause on the earth–sun line is investigated in the magnetohydrodynamic approximation. It is demonstrated that a rarefaction wave will reach the magnetosphere sometime after a shock wave reaches it because of secondary interactions. The time of this process is estimated with allowance for the effect of the interplanetary field. (auth)

25165 IRREGULAR PART OF THE FIELD OF GEOMAGNETIC STORMS AT MIDDLE LATITUDES. Afanas'eva, V. I.; Litinskii, V. M.; Sedova, F. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 811-813(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 953-954(1973).

The spectral composition of a storm field was studied from magnetic observations in L'vov, Odessa, Kazan, Sverdlovsk, and Srednikan. Standard records for 1959 were used. In all 8 large, 13 moderate, and 13 small storms were examined. The structure of the H component of the field was studied. (JFP)

25166 TWO TYPES OF GEOMAGNETIC FIELD PULSATIONS IN THE POLAR CAP. Zelenkova, L. V.; Men'shutina, I. N.; Pudovkin, M. I. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 814-816(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 955-957(1973).

To study pulsations in the polar cap, data from Mirny for 1960 to 1962 was used. Mirny is located under neutral currents and at 20–2h GLT in the auroral zone of the polar cap. Mirny has two pulsation regions on quiet days, nocturnal and diurnal. (JFP)

25167 SOLAR WIND TORQUE AS AN INHIBITOR OF TERRESTRIAL ROTATION. Hines, C. O. (Univ. of Toronto). J. Geophys. Res.; 79: No. 10, 1543-1545(1 Apr 1974).

Coleman [1971] has suggested that the solar wind may exert sufficient torque on the terrestrial magnetosphere to effect observable changes in the earth's rate of rotation. Hirshberg [1972] has examined the torque available from the solar wind and has concluded that it is too small for the purpose. It is argued here that Hirshberg's development and conclusion could be undermined by a variant on her model, but that other considerations lead ultimately back to her conclusion. These considerations concern the rate of rotation that the polar ionosphere would achieve under the driving effect of the solarwind torque and the resistive effect of viscous coupling through the neutral atmosphere from the ground. (auth)

25168 MAGNETOPAUSE RECONNECTION RATE. Sonnerup, B. U. O. (Dartmouth Coll., Hanover, NH). J. Geophys. Res.; 79: No. 10, 1546-1549(1 Apr 1974).

Certain aspects of the magnetic field reconnection process at the magnetopause, where the reconnecting fields usually are not equal and opposite, are discussed. It is argued that the upper limits on reconnection derived by Petschek [1964] on the one hand and Yeh and Axford [1970] and Sonnerup [1970] on the other may be reconciled, at least qualitatively. It is often stated that magnetopause reconnection, if it proceeds at the aforementioned upper limit, would have a $\sin(\theta/2)$ dependence upon the angle θ between the reconnecting fields. It is pointed out that this statement refers to the reconnection flow speed v. When the magnetic field Bo outside the magnetopause is weaker than the field Bi inside that surface, it appears that, for purely geometrical reasons, reconnection may cease altogether for $\cos\theta > Bo/Bi$. (MHR)

25169 HIGH-LATITUDE ELECTRIC FIELDS AND THE THREE-DIMENSIONAL INTERACTION BETWEEN THE INTERPLANETARY AND TERRESTRIAL MAGNETIC FIELDS. Mozer, F. S.; Gonzalez, W. D.; Bogott, F.; Kelley, M. C.; Schutz, S. (Univ. of California, Berkeley). J. Geophys. Res.; 79: No. 1, 56-63(1 Jan 1974).

More than 200 hours of ionospheric electric field measurements taken on balloons flown from three polar cap sites have been analyzed to determine average properties of the large-scale polar cap electric field and its dependencies on the interplanetary magnetic field. The major component of this electric field was directed from dawn to dusk and produced an average polar cap potential drop of about 55 kV. The magnitude of this potential provides an upper limit of about 700 R_E for the length of the magnetospheric tail and implies an energy input from the solar wind to the magnetosphere of about 5×10^{19} ergs/sec. The dawn to dusk component of the high-latitude polar cap electric field responds to B_z, the northward component of the interplanetary magnetic field, on a time scale $\lesssim$1 hour and with an average increase of about 3 mV/m for each 1 γ decrease of B_z. The hourly averages of the electric field data at each of the three sites are well described by a two-cell convection pattern whose location depends on the y component of the interplanetary magnetic field. When B_y is positive (negative), the two-cell convection pattern shifts toward dawn (dusk) in the northern hemisphere with the following consequences: the maximum intensity of the northern polar cap dawn to dusk electric field component occurs at local morning (evening), and the auroral zone return flow reaches higher latitudes in the evening (morning). Evidence of the vector nature of the interaction between interplanetary and terrestrial magnetic fields is provided by the observation that the above B_y dependent signatures are most evident when B_z is most negative. (auth)

25170 GEOMAGNETIC ACTIVITY IN THE VICINITY OF SECTOR BOUNDARIES. Shapiro, R. (Air Force Cambridge Research Labs., Bedford, MA). J. Geophys. Res.; 79: No. 1, 289-291(1 Jan 1974).

A superposed epoch analysis is presented of the daily sum of

Kp from 182 days before to 182 days after 112 spacecraft-observed and well-defined sector boundary crossing during the period 1962-1970. Although the most prominent feature of the association between sector boundary passage and Kp appears to be the minimum on day −1, this feature is most characteristic of sector boundary transitions from positive to negative polarity. (MHR)

25171 ORIGIN OF THE SEMI-ANNUAL VARIATION OF GEOMAGNETIC Kp INDICES. Murayama, T. (Nagoya Univ., Japan). J. Geophys. Res.; 79: No. 1, 297-300(1 Jan 1974).

The origin of the semiannual variation in the Kp index studied on the basis of the analysis of how the amplitude and the phase of the semiannual variation change with the solar activity. Data of Kp indices used in the analysis are the daily sums of Kp(ΣKp) for the period 1932-1971. (MHR)

25172 WESTWARD EQUATORIAL ELECTROJET DURING DAYTIME HOURS. Rastogi, R. G. (Univ. of Denver). J. Geophys. Res.; 79: No. 10, 1503-1512(1 Apr 1974).

The phenomenon of the depression of the geomagnetic horizontal field during the daytime hours of magnetically quiet days at equatorial stations is described. These events are generally seen around 0700 and 1600 LT, being more frequent during the evening than the morning hours. The evening events are more frequent during periods of low solar activity and in the longitude region of weak equatorial electrojet currents. The latitudinal extent of the phenomenon is limited to the normal equatorial electrojet region, and on some occasions the phenomenon is not seen at both stations, separated by only a few hours in longitude. During such an event the latitudinal profile of the geomagnetic vertical field across the equator is reversed, the ionospheric drift near the equator is reversed toward the east, the q type of sporadic E layer is completely absent, and the height of the peak ionization in the F_2 region is decreased. It is suggested that these effects are due to a narrow band of current flowing westward in the E region of the ionosphere and within the latitude region of the normal equatorial electrojet due to the reversal of the east-west electrostatic field at low latitudes. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstract 25726.

25173 (AD-775908/7) LOW POWER THERMAL IONIZATION ION SOURCES FOR THE PRODUCTION OF INDIUM, BARIUM, AND THALLIUM IONS. Keever, W. C.; James, D. R.; Graham, E. IV; McDaniel, E. W. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). 15 Mar 1974. 20p. NTIS $3.00.

Several small low-power thermal ionization ion sources have been developed for the non-alkali elements indium, barium, and thallium. Power consumption, lifetimes, and ion currents are reported. The sources are of the single-filament design with a charge painted on the surface and the multifilament design with one filament used to vaporize the charge and a second filament used to ionize the vapor. The latter design uses a resistively heated spiral-wound rhenium ribbon in the end of the vapor duct for the ionizer. (GRA)

25174 (CONF-741009-1) REFLECTION OF LOW ENERGY HYDROGEN ATOMS FROM METAL SURFACES. Robinson, M. T. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. 21p. Dep. NTIS $4.25.

From 3rd national conference on atomic collisions with solids; Kiev, USSR (14 Oct 1974).

The reflection of 50 to 500 eV H atoms from polycrystalline Cu surfaces was studied using the displacement cascade simulation program MARLOWE. The importance of inelastic effects is emphasized. Particle and energy reflection coefficients are presented as functions of the energy and angle of incidence of the projectiles. (auth)

25175 (KHFTI-72-50, pp 16-23) SMALL OIL-DIFFUSION PUMP M-1000. Sivokon, V. V. 1972. (In Russian).

Information on the development of the M-1000 is reported. The construction characteristics are described and the characteristics of the M-1000 three-stage oil diffusion pump are given. The pump was designed for the creation of a vacuum in heavy ion sources. The limiting vacuum during operation in oil (without a cold trap) is 2×10^{-7} mm Hg. The average pumping rate in the pressure interval from 1×10^{-5} to 2×10^{-4} mm Hg is 950 to 1000 l/sec. The ratio of the height and internal diameter of the pump is 1.28. (tr-auth)

25176 (SLL-74-8204) NEUTRAL BEAM SOURCES: APPLICATIONS IN SCIENCE AND TECHNOLOGY. Bauer, W.; EerNisse, E. P.; Mattern, P. L.; Musket, R. G.; Schmieder, R. W.; Thomas, G. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. 145p. Dep. NTIS $10.25.

Applications of neutral beam sources in science and technology, excluding the primary use of heating CTR plasmas, have been studied and evaluated. In this report current and planned neutral beam sources are described and their performance parameters are summarized. The most promising applications are in CTR-related materials research. The use of neutral beams for pumping lasers and masers and for producing neutrons and x-rays is described. Suggestions for employing neutral beam sources for machining glasses and ceramics and implanting atoms in metals and semiconductors are also discussed. (auth)

25177 (UCID-15544) POWER SUPPLY, 50 kW, 25 kV, 2A VOLTAGE REGULATED OUTPUT VOLTAGE CONTINUOUSLY VARIABLE, ADJUSTABLE OUTPUT CURRENT LIMITING VOLTAGE PROGRAMMABLE. Waugh, A. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 May 1967. 32p. Dep. NTIS $4.75.

Specifications are given for the design, operation, and performance testing of a 50 kW, high voltage, voltage regulated dc power supply working off a 480 V, 3 phase ac line and with a maximum continuous dc output of 25 kV and 2 amperes, with the negative side of the output grounded. The output current and voltage are adjustable over a limited range. The power supply is designed for a hydrogen or deuterium ion source. (WHK)

25178 (UCRL-Trans-1517) STUDY OF THE CONDITIONS REQUIRED FOR THE AXIAL EXTRACTION OF MULTI-CHARGED IONS FROM A CONFINED ELECTRON BEAM SOURCE. Tuan Ton-That. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1972. Translation by M. Martin of FRNC-TH-388. 113p. Dep. NTIS $8.75.

Thesis.

A new type of source (designated: confined electron beam source) was studied. In this source the electrons, themselves, produce the ionization and also serve to confine the ions. The electrons have a very narrow velocity distribution; very few collisions occur in their paths and no 180° reflections; when the ions are extracted, the electrons are simultaneously extracted from the source. In addition, all the fields and potentials possess a symmetry of revolution as well as extraction symmetry. The device is briefly described and the space charge phenomenon in the source is analyzed. This analysis enables the depth of the potential well generated by the electron beam traversing the drift tubes to be determined. The solving of the general equation of motion was effected using the SPACH and IONEL calculation programs. The beam is nonlaminar and its charge density is not constant in the straight sections. In the calculation, the beam cannot be represented by the total number of particles; studies of the distribution of currents necessitate the introduction of the macroparticle concept. (FR)

25179 EFFECT OF CHANGES IN THE POTENTIAL ON ATOM-SOLID ELASTIC SCATTERING. Wolken, G. Jr. (Department of Chemistry, Illinois Institute of Technology, Chicago, Illinois 60616). J. Chem. Phys. 61: No. 2, 456-460 (15 July 1974).

The relative intensity appearing in various diffraction peaks for the elastic scattering of an atom from a solid surface is studied as aspects of the interaction potential are varied. It is observed that the detailed relationship between the flat portion of the potential $V_0(z)$ and the (x,y) -dependent part on the repulsive wall (in the general region of the classical turning point) most strongly affects the diffraction properties. The scattering is relatively insensitive to the long range behavior of the flat part of the potential $V_0(z)$ and the long range behavior of the (x,y) -dependent parts. (auth)

25180 ENERGY DEPENDENCE OF THE Kα SATELLITE INTENSITY FROM HIGH-ENERGY ELECTRON-IMPACT IONIZATION. Cue, N.; Scholz, W. (Department of Physics, State University of New York at Albany, Albany, New York 12222). Phys. Rev. Lett.

The relative x-ray yields corresponding to KL and K ionized atoms have been measured for elements ranging from V ($Z = 23$) to Ni ($Z = 28$) at incident electron energies of 20 keV and 2 MeV. The intensity ratios of $K\alpha$ satellite to diagram lines at 2 MeV are found to be lower by a factor ~ 0.6 than those measured at 20 keV. These results cannot be understood solely in terms of electron shakeoff. It is suggested that the observed energy dependence is due to a competing multiple Coulomb-ionization mechanism.

25181 DETECTION AND ELIMINATION OF REFLECTIONS IN BEAM-FOIL TARGET CHAMBERS. Bickel, W.S. (Physics Department, University of Arizona, Tucson, Arizona 85271). Appl. Opt. 13: No. 6, 1295-1296 (June 1974).

We employ a small pea-lamp and a second set of slits to eliminate reflections in our beam-foil experiments. (AIP)

25182 INTERACTIONS OF HYPERTHERMAL ATOMIC BEAMS WITH SOLID SURFACES. Liu, S.M.; Rodgers, W.E.; Knuth, E.L. (Energy and Kinetics Department, School of Engineering and Applied Science, University of California at Los Angeles, Los Angeles, California 90024). J. Chem. Phys. 61: No. 3, 902-904 (1 Aug 1974).

Interactions of high-energy supersonic atomic beams with solid surfaces and surface contaminants have been studied experimentally. In situ Auger electron spectroscopy indicates that hydrocarbons from the oil diffusion pump are the major contaminants. The hypothesis that a threshold energy exists for sputtering of these surface contaminants by an incident beam has been further tested. The dependence of the threshold energy on the incident-beam angle has been examined for three different incident-beam angles, namely 50°, 60°, and 70° from the surface normal. A simple correlating expression for $E_{th}(\mu,\theta_i)$ has been derived. (auth)

25183 PHOTOIONIZATION SOURCE OF MONOENERGETIC ELECTRONS. Gallagher, A. C.; York, G. (Univ. of Colorado, Boulder). Rev. Sci. Instrum.; 45: No. 5, 662-668(May 1974).

A photoionization source of monoenergetic electrons is described and design criteria for such sources are discussed. The present design produces a beam of $\sim 10^{-12}$ to 10^{-13} A by photoionization of a metastable ($^1D_2$) barium beam inside the cavity of a He-Cd laser operating at 3250 Å. The photoelectrons are produced with 17 MeV kinetic energy and a calculated energy spread of < 1 MeV. Energy analysis is provided by measuring the width of the 11.08 eV argon resonance. The observed width of this resonance has, to date, been limited to ~6 MeV, but tests are reported which indicate that this width is largely due to Doppler spreading in the target atomic beam and potential gradients across the collision volume. (auth)

25184 MONTE CARLO CALCULATION OF LOW-ENERGY SECONDARY ELECTRON EMISSION FROM METALS. Koshikawa, T.; Shimizu, R. (Osaka Univ.). J. Phys., D (London); 7: No. 9, 1303-1315(11 Jun 1974).

A Monte Carlo simulation is applied to investigate the escape process of the secondary electrons in a metal. The calculated energy distribution of secondary electrons agrees satisfactorily with the experimental results. The lateral distribution of secondary electrons is also calculated and is ~10 Å for normal incidence, which corresponds to the theoretical limit of the scanning electron microscope in the image of secondary electrons. The decay of slow secondary electrons is shown not to obey a simple exponential decay law because of the cascade process from the calculation of the depth distribution. The calculated results suggest that a higher resolution in the scanning electron microscope can be attained by detecting only the secondary electrons with higher energies. The energy distribution of secondary electrons excited by Auger electrons is widely spread over the range between zero and the characteristic energy of Auger electrons. (auth)

25185 ENERGY SPECTRUM OF FAST SECONDARY ELECTRONS BACKSCATTERED FROM A SOLID SURFACE. Levandovskii, V. G.; Chaika, G. E. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 6, 976-982(Jun 1974). (In Russian).

The energy distribution of fast backscattered electrons was calculated on the basis of the Boltzmann kinetic equation. Single and multiple scatterings were taken into consideration. It was shown that the energy spectrum of backscattered electrons has the extremum near the value of the primary flux energy. The peak energy–Z dependence was in good agreement with the experimental results. (1 figure) (auth)

25186 METHOD FOR INCREASING THE APERTURE OF SPACE FOCUSING LENSES. Wharton, L. (Univ. of Chicago). Rev. Sci. Instrum.; 45: No. 6, 825-826(Jun 1974).

There are limitations in the aperture achievable from the use of molecular beam space focusing lenses. It is shown that by a system of lenses in series (or by a lens with varying strength along its axis) the aperture can be made substantially larger than in the case of a single lens. A method for the design of such a system is given. The use of this method to design a collimator is presented. More powerful lens systems can enhance the sensitivity, signal-to-noise ratio, and resolution of maser beam, molecular beam resonance, and state selecting scattering apparatus that commonly employ these lenses. (auth)

Atomic and Molecular Properties

Refer also to abstracts 23558, 23801, 23805, and 24655.

25187 (ORO-3346-153) INVESTIGATION OF X-RAY FLUORESCENCE YIELDS AND OF THE COSTER-KRONIG TRANSITION PROBABILITIES FOR THE L_2 AND L_3 SUBSHELLS IN THE HIGH-Z REGION. Nix, D. W. (Georgia Inst. of Tech., Atlanta (USA)). Aug 1974. 155p. Dep. NTIS $10.75.

Thesis.

An experimental study of the L_2- and L_3-subshell fluorescence yields (ω_2 and ω_3) and the L_2-L_3 Coster-Kronig transition probability (f_{23}) in the high-Z region and an experimental study of mean L-shell fluorescence yields ($\bar{\omega}_L$) at Z = 47, 60, and 63 are reported. The following experimental results are obtained: $f_{23}(Z = 80) = 0.123 \pm 0.012$, $f_{23}(Z = 81) = 0.109 \pm 0.011$, $f_{23}(Z = 82) = 0.105 \pm 0.011$, $f_{23}(Z = 86) = 0.105 \pm 0.011$, $f_{23}(Z = 88) = 0.053 \pm 0.052$, $f_{23}(Z = 92) = 0.147 \pm 0.010$, $f_{23}(Z = 94) = 0.226 \pm 0.016$, $\omega_2(Z = 86) = 0.459 \pm 0.025$, $\omega_2(Z = 88) = 0.493 \pm 0.030$, $\omega_2(Z = 92) = 0.560 \pm 0.033$, $\omega_2(Z = 94) = 0.513 \pm 0.022$, $\omega_3(Z = 86) = 0.384 \pm 0.020$, $\omega_3(Z = 88) = 0.408 \pm 0.027$, $\omega_3(Z = 92) = 0.481 \pm 0.029$, $\omega_3(Z = 94) = 0.509 \pm 0.029$, $\bar{\omega}_L(Z = 47) = 0.0425 \pm 0.0064$, $\bar{\omega}_L(Z = 60) = 0.131 \pm 0.017$, $\bar{\omega}_L(Z = 63) = 0.142 \pm 0.023$. A comparison of the "most reliable" experimental values of the L_2-L_3 Coster-Kronig transition probability, f_{23}, selected on the basis of rigid criteria from the present results and from published results, with current theoretical predictions allows the following conclusions to be drawn: The experimental values of f_{23} are in general agreement with theoretical results in the region $63 \leq Z \leq 88$. The theoretical prediction of McGuire agrees with the experimental result at Z = 96, where both $L_2-L_3M_{4,5}$ transitions are well above threshold and contribute fully. The experimental results at Z = 92 seem to indicate that the $L_2-L_3M_4$ transition is very near threshold and contributes only part of its full intensity to the value of f_{23}. The disagreement of approximately 25 percent at Z = 94 between the theoretical prediction of Chen and Crasemann [using the independent particle model (IPM) with a Green-Sellin-Zachor (GSZ) potential] and the experimental results is attributed to the inaccuracy of the theoretical prediction caused by the inaccuracy of the adjustable parameters used in the Green-Sellin-Zachor potential. Comparison of mean L-shell and of L_2- and L_3-subshell fluorescence yields with theoretical predictions leads to the following conclusions: At Z = 47, the theoretical mean L-shell fluorescence yield predictions of Chen and Crasemann agree better with experiment than do those of McGuire. Although there is overall good agreement between experiment and McGuire's theory for ω_2, the available experimental accuracy (limited mainly by uncertainties in detector efficiency) is not sufficient to distinguish between the theoretical predictions due to McGuire and those due to Chen, Crasemann, and Kostroun; however, it appears to rule out the IPM calculation with the GSZ potential by Chen and Crasemann. The discrepancy between the experimental results obtained by using the L_α gating coincidence technique and the $K_{\alpha 1,2}$ gating coincidence techniques was studied. It was found that these techniques are equivalent and that any discrepancy between them is due to improperly applied corrections to the experimentally determined quantities used to calculate f_{23}. The possible use of highly oriented graphite (HOG) mosaic curved crystals for determination of x-ray fluorescence and Coster-Kronig yields was evaluated. It was found that the problems arising from low efficiency makes coincidence studies impossible within a reasonable time. In addition, the problems arising from low efficiency, source attenuation, and assumptions of quantities from other measurements in the singles use of HOG crystals makes it difficult to use them for precise measurements of fluorescence and Coster-Kronig yields. (12 figures, 13 tables, 162 references) (auth)

25188 EMISSION PROFILES OF LASER-INDUCED OPTICAL SATELLITE LINES IN A HELIUM PLASMA. Prosnitz, D.; George, E.V. (Department of Physics and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. Lett. 32: No. 23, 1282-1286 (10 June 1974).

We have measured the spectral line profiles of the optical satellites emanating from the (2^3S, 2^3P)-(4^3S, 4^3P) excited state manifolds of a low-pressure helium plasma. These satellites are induced by the presence of a CO_2 laser field. Detailed spectra are presented for the 2^3P-4^3S, 4713-Å He I allowed line and its associated near satellite. A theoretical model, valid for large, near-resonant interactions is described. This theory is seen to be in good agreement with the experimental results. (auth)

25189 PRECISION MEASUREMENT OF THE RYDBERG CONSTANT BY LASER SATURATION SPECTROSCOPY OF THE BALMER α LINE IN HYDROGEN AND DEUTERIUM. Hänsch, T.W.; Nayfeh, M.H.; Lee, S.A.; Curry, S.M.; Shahin, I.S. (Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 32: No. 24, 1336-1340 (17 June 1974).

We have determined a new Rydberg value, $R_\infty = 109\ 737.314\ 3(10)$ cm^{-1}, with an order of magnitude improvement in precision, by measuring the absolute wavelengths of resolved fine-structure components of the Balmer α line in hydrogen and deuterium, excited in a dc gas discharge. Doppler broadening was eliminated by saturation spectroscopy with a pulsed dye laser. An iodine-stabilized He-Ne laser was the wavelength standard. Possible sources of systematic errors have been carefully investigated. (auth)

25190 DETERMINATION OF THE LIFETIME FOR THE 4^1P_1 LEVEL OF THE HELIUM ATOM BY STUDYING THE ALIGNMENT IN THE DISCHARGE. Kazantsev, S.A.; Markov, V.P. Opt. Spectrosc. (USSR) 36: No. 3, 355-356 (Mar 1974).

The alignment of excited atoms in the positive column of a gas discharge was for the first time described in Refs. 1 and 2. In later studies this effect was used for the determination of the radiation lifetime of excited atoms.[3-5] In Ref. 4, the alignment of some excited states of the helium atom was observed and the lifetimes of the n^1D_2(n=3-5) and 3^1P_1 levels of helium atom were determined with the Hanle method. (auth)

25191 SYSTEM OF HARTREE-TYPE EQUATIONS FOR QUASI-STATIONARY STATES. CALCULATION OF THE ENERGY AND WIDTH OF LEVELS OF DOUBLY EXCITED HELIUM. Kuchinskiĭ, V.V. Opt. Spectrosc. (USSR) 36: No. 3, 255-257 (Mar 1974).

We have constructed a system of equations of the Hartree-type to describe non-stationary states. As an example, we calculate the energy and the width of the doubly excited helium state $(2s3s)^1S$, which corresponds to a resonance in the scattering of an electron by He^+ at 35 eV. (auth)

25192 ADVANCES IN THE SPECTROSCOPY OF COMBINATION SCATTERING ON ELECTRONIC LEVELS OF LANTHANIDES. Koningstein, J. A. (Carleton Univ., Ottawa). Usp. Khim.; 42: No. 10, 1810-1842(Oct 1973). (In Russian).

Light scattered by low-lying electron levels of rare earth ions in the solid state was studied. This type of light scattering is

weaker than ordinary scattering by vibrational levels, but it has some theoretical (and experimental) peculiarities not found in the usual spectroscopy of coordination scattering. The influence of the Zeeman effect on the location of very strong electron transitions in terbium aluminum garnet with a centroid at 80 cm^{-1} was studied. In the elementary crystal cell there were six places for the rare earth ions, but fine structure was not observed in the experiment. All experimental results presented are related to the action of the crystal field on the rare earth ion. These data are especially important in clarifying the nature of the crystal field of some cubic crystals. Current studies have been extended to other fields, in particular to that of ions of the transition metals in the solid state. (tr-INIS)

25193 SPIN-OTHER-ORBIT AND SPIN-SPIN INTERACTIONS IN THE METASTABLE, c $^3\Pi_u(1s,2p)$ STATE OF H_2. Jette, A.N. (Applied Physics Laboratory, The Johns Hopkins University, Silver Spring, Maryland 20910). J. Chem. Phys. 61: No. 3, 816-819 (1 Aug 1974).

An ab initio calculation of the spin-other-orbit and spin-spin interactions in the c $^3\Pi_u(1s,2p)$ state of molecular hydrogen has been made. This calculation utilized the wavefunction obtained with the optimal double configuration model by Zemke, Lykos, and Wahl. The coupling constants are in good agreement with those calculated by Lombardi using the 45-50 configuration elliptic coordinate wavefunction of Rothenberg and Davidson. (auth)

25194 SHIFT OF A SIGNAL OF INTERSECTION OF THE BASIC STATE SUBLEVELS OF ATOMS ^{199}Hg AND ^{201}Hg IN A ROTATING rf FIELD. Novikov, L. N.; Bartenev, O. A. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 2, 289-291 (1974). (In Russian).

Experiments on the subject effect showed it to be related to the nonlinearity of the interaction of the spin system with two radiofrequency fields and that it cannot be described in the framework of linear theory. (SJR)

25195 MEASUREMENT OF U I AND U II RELATIVE gf-VALUES. Voight, P. A. Washington, DC; Catholic Univ. of America (1974). 71p. University Microfilms Order No. 74-19,078.

Thesis (Ph. D.).

Relative gf-values of forty-nine prominent U II lines in the visible and near uv were measured in a wall stabilized arc. The arc is initially operated with argon flowing into all sections except the center where a 95 Ar−5% H mixture is used. The Ar−H mixture passes by the mouth of a heated bottle of UF_6 crystals so that a controllable amount of uranium can also be introduced into the central section. The electron density is obtained from the width of the hydrogen Balmer line H_β and the initial temperature calculated from the Saha equation applied to argon. The addition of uranium produces a temperature lowering which is calculated from the decrease in intensity of the argon line. All runs were made at temperatures between 9500 and 11,000°K. Relative gf-values for twenty of the strongest U I lines were measured in a flow-stabilized arc. Even at the low temperature of the flow-stabilized arc (5500°K), the spectrum of U II is still predominant and hence only the strongest U I lines can be observed. The flow-stabilized arc is essentially a free burning arc which is stabilized by streaming argon around one of the electrodes which is formed from a molten ball of uranium held in a tungsten cup. Intensities are measured side-on and are Abel inverted to obtain values of the local emission coefficient. The temperature is determined by measuring the relative intensities of U II lines. The line intensities from both arcs are measured photoelectrically as they are scanned with a 0.75 m monochromator having a resolution of 0.05 Å in second order. The wave length response is calibrated by using a tungsten strip lamp. Variation of the uranium concentration was checked by monitoring the intensity of a strong U I or U II line. The results of the experiment are compared with an earlier, less refined experiment and a wave length dependent discrepancy is found. (Diss. Abstr. Int., B)

25196 CONSTRUCTION OF MULTI-PARTICLE GREEN'S FUNCTIONS. Luger, A. D. New York; New York Univ. (1973). 134p. University Microfilms Order No. 74-16,842.

Thesis (Ph. D.).

The problem of obtaining the Green's function for N noninteracting particles in single-particle potentials is considered. The Green's function satisfies the differential equation $[\sum_{i=1}^{N}(\nabla_i^2 + U_i(\vec{i})) + k^2]\, G(\vec{1}',\vec{2}',\ldots,\vec{N}';\vec{1},\vec{2},\ldots,\vec{N};k) = -\delta(\vec{1}-\vec{1}')\ldots\delta(\vec{N}-\vec{N}')$ and obeys bound-state boundary conditions. The 2N quantities $\vec{1},\vec{2},\ldots,\vec{N};\vec{1}',\vec{2}',\ldots,\vec{N}'$ are three dimensional position vectors. The asymptotic forms of the single-particle potentials must vanish at least as rapidly as a Coulombic potential. To construct the Green's function for single-particle systems, a theorem, referred to as the k-pole theorem, is formulated, and demonstrated on physical systems with known Green's functions. The multi-particle analog of the k-pole theorem is formulated, and the concept of correlated states is introduced. The correlation concept is demonstrated and the k-pole theorem used to generate the Green's function for a system of two noninteracting particles in a Coulomb potential. The first application of this two-particle Coulomb Green's function, the hydrogen Van Der Waal problem, is considered and the first nonvanishing correction to the energy is calculated. The second application is treating the helium atom's electronic repulsion as a perturbation on the noninteracting system. The energy and eigenfunction corrections are obtained. All three calculations agree with earlier theoretical results and experimental observation. Finally, arguments are outlined for the validity of the k-pole theorem with general non-Coulombic potential forms. (Diss. Abstr. Int., B)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 25239 and 25650.

25197 NUCLEAR-SIZE EFFECTS ON VACUUM POLARIZATION IN MUONIC Pb. Gyulassy, M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 32: No. 24, 1393-1396 (17 June 1974).

The effect of finite nuclear size on the vacuum-polarization charge density is studied. The results to third order $\alpha(Z\alpha)^3$, and to all orders $\alpha(Z\alpha)^n$, $n \geq 3$, are presented with special attention focused on the $5g_{9/2}$–$4f_{7/2}$ transition in muonic Pb. In addition, the accuracy of analytic calculations exploiting the smallness of the electron mass and of the nuclear radius is discussed. (auth)

25198 INTENSITY VARIATIONS OF K⁻-MESONIC X RAYS. Condo, G.T. (Department of Physics and Astronomy, University of Tennessee, Knoxville, Tennessee 37916). Phys. Rev. Lett. 33: No. 3, 126-128 (15 July 1974).

We show that there exists a strong correlation between the atomic diameter of target metals and their K⁻ mesonic x-ray intensity. The smaller x-ray intensities observed from smaller atoms suggests that the initial capture into large angular momentum states is inhibited in smaller stoms which could be understood if the meson is not localized about a single atom until its kinetic energy is somewhat less than has been presumed. This tendency for mesons to avoid higher angular momentum states when captured by small atoms also explains some previous muonic-atom results. (auth)

25199 DIFFUSION OF CHARACTERISTIC SLOW POSITRONS FROM SOLIDS. Pendyala, S. London, Ont.; Univ. of Western Ontario (1973). vp. National Library of Canada, Ottawa.

Thesis (Ph. D.).

For the first time, energy spectra of characteristic slow positrons were measured in the backscattering mode from aluminium, copper and gold and in the transmission mode from gold and mica. The main peaks are believed to originate from within the bulk and some of the fine structure appears to come from adsorbents on the solid surface. A work function model for the positron is proposed to explain the results. The intensity of the mica spectrum was shown to depend on the heat treatment of the mica. Measurements of the yield of slow positrons as a function of gold thickness in the transmission mode were made. By combining these results with the prediction of a phenomeno-logical model, the diffusion length of thermal positrons was determined to be $\sim 10^3$ Å in gold. Positrons were detected using a secondary electron multiplier. The secondary emission properties of the detector were studied under positron bombardment and compared with those due to electron and positive ion bombardment. (Diss. Abstr. Int., B)

25200 POSITRON LIFETIME MEASUREMENTS IN DEFORMED METALS. Lynn, K. G. Salt Lake City; Univ. of Utah (1974). University Microfilms Order No. 74-17,518.

Thesis (Ph. D.).

Positron lifetime measurements were conducted on Cu, Ni, and a Ni-66.5% Co alloy. Mean positron lifetimes were measured as a function of tensile strain in Cu with grain sizes of 169, 264, and 309 μm. Saturation of the positron lifetime was approached at values of strain proportional to the original grain diameter. The percentage of trapped positrons was evaluated for the 264 μm material. Quantitative agreement was found between the 264 μm grain size material and the trapping models of Conners and West, and Bergerson and Stott. The mean positron lifetime was found to roughly follow an inverse dependence on the grain diameter. Periodic measurements of positron lifetime and x-ray line broadening were made at various times during the plastic fatigue cycling of pure Ni and a Ni-66.5% Co alloy. Observations of the sub-

structure at fracture were made by transmission electron microscopy. The positron lifetime increases rapidly during the early part of the fatigue life and remains almost constant thereafter. The mean positron lifetime changes from about 140 psec to about 230 psec during fatigue. This early saturation of positron lifetime far precedes the saturation of the change in x-ray particle size. The positron lifetime varies as a function of the dislocation density. A number of significant improvements in positron lifetime techniques were developed in order to improve the accuracy of determining positron lifetimes. Improvements in data analysis included the removal of all fixed parameters. (Diss. Abstr. Int., B)

Collision Phenomena

Refer also to abstracts 25087, 25724, and 25725.

25201 (COO-2276-2) ENERGY LOSSES DUE TO BREMSSTRAHLUNG PROCESSES ON PARTIALLY STRIPPED IMPURITY IONS. Russek, A.; Haller, K.; Sohn, R. (Connecticut Univ., Storrs (USA)). 19 Mar 1974. Contract AT(11-1)-2276. 17p. Dep. NTIS $4.00.

The well known formula describing the cross section for photon emission when a nonrelativistic electron is scattered by a point charge is generalized. A simple analytic formula is derived for the cross section for photon emission by a nonrelativistic electron incident on a screened charge for which the scattering potential is expressible in the form: $V(r) = e(N/r\, e^{-r/r_p} + Z - N/r\, e^{-r\,r}a)$. This potential is a good approximation for an impurity atom of charge Z which was stripped of N electron. A plasma screening distance, r_p, is incorporated, if desired. A good approximation for the ion core screening radius r_a is $r_a = a_0/Z^{\frac{1}{3}}$, a_0 being the Bohr radius (= 0.53 Å). (auth)

25202 (FRNC-TH-486) STUDY OF INTERFERENCES BETWEEN ZEEMAN SUB-LEVELS OF THE 3^3p STATE OF ^{4}HeI EXCITED BY THE BEAM-FOIL TECHNIQUE. Zgainski, A. (Lyon-1 Univ., 69 (France)). 1973. 104p. (In French). Dep. NTIS (US Sales Only) $8.25.

Thesis.

The modulations produced in the light emitted by an accelerated ion beam excited by a thin target (beam-foil excitation) in the presence of a uniform transverse magnetic field were studied for the $1s2s^3S$-$1s3p^3P$ transition of neutral ^{4}He I. The excitation is described together with the behavior of atoms in the density matrix formalism, the light emitted and the observation of this light in the detection matrix. Emphasis is given to the necessity of providing a simultaneous excitation and coherent detection system for the observation of the light beats. The calculations are performed in the $LSM_{(L)}M_{(S)}>$ decoupled representation. The modulation frequency, which can be accurately obtained from the temporal resolution associated with the high velocity of the beam, enables the structure of the excited level to be determined. This structure is defined by different couplings between the angular momenta in the excited atom or ion and by the perturbation due to the magnetic field. The method provides information on fine and hyperfine Zeeman structures and the Lande factors of the excited levels of multicharged ions, and can be used to accurately determine the beam velocity. (auth)

25203 (INIS-mf-1343) MEASUREMENTS ON THE ORIENTATION DEPENDENT CROSS SECTION OF HYDROGEN. Moerkerken, H. C. A. H. (Katholieke Universiteit Nijmegen (Netherlands)). 14 Feb 1974. 100p. INIS.

The anisotropy of the intermolecular potential of the system consisting of H_2 and one of the rare gas atoms Ar, Kr or Xe and of the system H_2 and the molecules N_2 or CO_2 was studied with molecular beam experiments. The experimental set-up, the method of producing a hydrogen beam and the scattering box are discussed. The anisotropic potentials as they are employed in collision theory are dealt with. A model based on distorted wave approximation was chosen for the interpretation of the measurements. The relative difference between the cross sections for two different states of the hydrogen molecule is measured for the collision partners in the velocity range 1270 to 1820 m s^{-1}. From an interpretation of these measurements the following is concluded. The parameters used for the isotropic part of the potential must be lowered considerably. For all systems, except those containing CO_2, the ratio between the short-range anisotropy parameter $q_{2,12}$ and the long-range parameter $q_{2,6}$ is 2.7 (±.3). The value of the long-range anisotropy parameter $q_{2,6}$ of H_2 is determined as .2. (auth)

25204 (JINR-E7-8006) QUASIMOLECULAR KX-RAY EXCITATION BY BOMBARDING As, Zr, Nb, Mo AND Rh TARGETS WITH Nb IONS. Gippner, P.; Kaun, K. H.; Sodan, H.; Stary, F.; Schulze, W.; Tret'yakov, Yu. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 13p. Dep. NTIS (U. S. Sales Only) $4.00.

By bombarding various targets with 65 and 40 MeV ions continuous x-ray distributions were obtained, which range up to the Kx-ray energies of quasiatoms with $Z = Z_1 + Z_2$. The high energy parts of these continua are interpreted as Kx-radiation of quasimolecules transiently formed during the adiabatic heavy ion-atomic collisions. (auth)

25205 (UCRL-51596) MEASUREMENT OF THE DIFFERENTIAL CROSS SECTION FOR COMPTON SCATTERING BY BOUND ELECTRONS. Spitale, G. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Jun 1974. Contract W-7405-Eng-48. 44p. Dep. NTIS $4.00.

Thesis.

Singly differential cross sections for incoherent scattering by K-shell electrons were measured for incident photons having energies of 662, 320, and 145 keV. The spectral distributions of scattered photons were also examined. Target materials were iron, tin, holmium, and gold at 320 keV; tin and gold at 662 keV; and iron and tin at 145 keV. It was not, however, possible to draw specific conclusions from the 145-keV data. A typical spectrum at 320 keV consisted of a scattered peak which was much narrower than would be expected from the bound state electron motion. Rather than monotonically increasing with atomic number as expected, the peak width reached a maximum near Z = 50 and then decreased with increasing atomic number. The peak also reached a maximum width for a scattering angle between 45 and 60°. The same angular behavior was observed at 662 keV, and the peaks in the gold spectra were narrower than corresponding peaks in the tin spectra. The peak is superimposed on a continuum which appears to diverge at the low end of the scattered photon spectrum for the following cases: gold, holmium, and tin targets for 320-keV incident photons; and gold and possibly tin targets for 662-keV photons incident. This infrared divergence is expected on general grounds and was predicted. The observed "infrared" continuum is very nearly isotropic. As far as is known, no other experimental work has shown these anomalous effects. (auth)

25206 PRODUCTION OF SLOW NEGATIVE IONS IN COLLISIONS OF FAST H^+, H^0, AND H^- WITH CO. Afrosimov, V.V.; Leiko, G.A.; Mamaev, Y.A.; Panov, M.N.; Vujovich, M. (A. I. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Tech. Phys. 18: No. 10, 1346-1348 (Apr 1974).

The cross sections for the production of O^- and C^- ions in collisions of protons, hydrogen atoms, and negative hydrogen ions, with CO molecules have been measured for kinetic energies of the incident hydrogen particles in the range 5–50 keV. A coincidence method is used to analyze the charge state of all particles produced in H^k–CO collisions with k = +1,0,–1. In all cases O^- and C^- ions result from the direct dissociation of the molecules into negative and positive ions. If the process in which an electron is captured from an incident H^0 or H^- particle by a CO molecule and in which the $(CO)^-$ system subsequently dissociates into negative and neutral atoms does in fact occur, its role is negligible. (auth)

25207 IONIZING COLLISIONS OF FAST ALKALI ATOMS WITH Cl_2, Br_2, AND O_2. Kashihira, N.; Schmidt-Bleek, F. (The University of Tennessee, Knoxville, Tennessee 37916); Datz, S. J. Chem. Phys. 61: No. 1, 160-167 (1 July 1974).

A time-of-flight apparatus is described for measuring the inelastic energy loss incurred by fast (<50–350 eV) alkali atoms in ionizing collisions with diatomic molecules. The inelastic energy losses were found to be nearly energy independent for collisions between K and Cs with Cl_2, Br_2, and O_2, and it is furthermore shown that these energy losses are from about 8 to 10 eV, irrespective of the reactants. The collisions between alkali atoms and halogen molecules (Cl_2 and Br_2) yield as intermediate alkali ions (M^+) and excited molecular ions, (X_2^-) in the $^2\Sigma_g$ state, followed by dissociation to the ground-state halogen ions and excited halogen atoms. In the case of oxygen, excited molecular ions in the $^2\pi_u$ state are formed and these species either remain in the bound state of the $^2\pi_u$ or decay to vibrationally excited molecular states ($^2\Sigma_g^+$,$^2\Delta_g$). The excitation functions (change of cross sections with incident energy variations) are interpreted in terms of curve crossings near or inside the equilibrium distance of the $M–X_2$ potential surfaces. A comparison of the results obtained at high energies (20–200 eV c.m.) is made to those known from collision energies between 1 and 20 eV (c.m.) and a composite excitation function for the three most probable processes over the whole energy range is constructed. (auth)

25208 CALCULATION OF IONIZATION PROBABILITY FROM EXPERIMENTAL DATA. dos Santos, A.F.; Figanier, J. (Instituto Superior Técnico, Lisboa, Portugal). J. Chem. Phys. 61: No. 1, 198-202 (1 July 1974).

In this paper the description is made of a mathematical method of estimating the probability of ionization of molecules from experimental

data, assuming that the emission energy of the ionizing electrons is known. The method does not require any assumption about the shape of the experimental curves outside the range of the equipment and makes it possible to obtain a certain noise removal by using physical knowledge about the ionization probability. The method is tested through an artificial example, the results being in closer agreement with the "true" curve than those obtained by other methods. (auth)

25209 ON A GENERAL RELATIONSHIP BETWEEN SOLUTIONS OF ALTERNATIVE SETS OF EQUATIONS FOR REARRANGEMENT CHANNEL T OPERATORS. Kouri, D.J. (Max-Planck-Institut für Strömungsforschung, 34 Göttingen, Böttingerstrasse 6-8, Federal Republic of Germany); Levin, F.S.; Craigie, M.; Secrest, D. J. Chem. Phys. 61: No. 1, 17-20 (1 July 1974).

A general relationship between the solutions for two alternative sets of coupled equations for channel T operators describing rearrangement scattering is derived. The relation involves analogously defined channel K operators for rearrangement scattering. A symmetrized form of the relationship is also derived that can account for differing numerical results obtained in recent coupled T equation studies of e-H scattering. (auth)

25210 USE OF CONTRACTED BASIS FUNCTIONS IN ALGEBRAIC VARIATIONAL SCATTERING CALCULATIONS. Abdallah, J. Jr.; Truhlar, D.G. (Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). J. Chem. Phys. 61: No. 1, 30-36 (1 July 1974).

Schemes for the use of contracted basis functions in algebraic variational electron scattering calculations are presented. These schemes are tested by computing partial cross sections for the scattering of electrons by atomic hydrogen for several contracted and uncontracted basis sets. The results indicate that the use of contracted functions is an effective means of circumventing lengthy algebraic computations without much loss of accuracy. One contraction scheme provides a method intermediate in accuracy and volume of computations required between the distorted wave method and the close coupling method. Another provides a method intermediate in accuracy and volume of computations required between an M-channel close coupling calculation and an $(M+M')$ -channel close coupling calculation where M' is the number of channels in which the number of contracted functions is insufficient for convergence. (auth)

25211 QUANTUM MECHANICAL THEORY OF TRANSLATION-INTERNAL MODE ENERGY TRANSFER IN COLLISIONS OF ATOMS WITH DIATOMIC SYSTEMS. Csanak, G.; Taylor, H.S.; Varracchio, E.F. (Department of Chemistry, University of Southern California, Los Angeles, California 90007). J. Chem. Phys. 61: No. 1, 263-270 (1 July 1974).

The field theoretical Green's function technique has been used to define an elastic scattering optical and inelastic scattering transition potential for the structureless atom-diatom scattering problem. The functional differentiation technique of Schwinger has been utilized to generate approximations for these potentials. First and second order approximations are given and their physical interpretation discussed. (auth)

25212 HIGH-RESOLUTION STUDIES OF TOTAL ELECTRON EXCITATION FUNCTIONS NEAR THRESHOLD FOR THE STATES B $^1\Sigma_u^+$ AND c $^3\Pi_u$ OF MOLECULAR HYDROGEN. Elston, S.B.; Lawton, S.A.; Pichanick, F.M.J. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. A 10: No. 1, 225-230 (July 1974).

Studies have been made of uv and metastable excitation functions for H_2 near threshold. Within 2 eV of threshold the total cross sections appear to be dominated by two vibrational series of resonances. In the excitation function of B $^1\Sigma_u^+$ (uv emitting), one series (band "a") is ten times more intense than the other (band "c"), while for c $^3\Pi_u$ excitation (metastable), the two series have approximately equal intensity. The measured energy positions of the resonant peaks agree well with results obtained by other experimental techniques and with theory. Energy calibration of the metastable excitation function has confirmed that the c $^3\Pi_u$ ($v = 0$) level is metastable, and there was no obvious threshold for a second metastable vibrational level, although the nature of the data does not preclude its existence. (auth)

25213 IONIZATION CROSS SECTIONS AND PROBABILITIES FOR REMOVAL OF 2s AND 2p ATOMIC ELECTRONS IN THE BINARY-ENCOUNTER APPROXIMATION. McGuire, J.H.; Omidvar, K. (Theoretical Studies Branch, NASA-Goddard Space Flight Center, Greenbelt, Maryland 20771). Phys. Rev. A 10: No. 1, 182-189 (July 1974).

Calculations of ionization cross sections have been performed for removing electrons from 2s and 2p levels in hydrogenlike atoms by heavy-charged-particle impact using the binary-encounter approximation (BEA). The ratio of σ_{LII}/σ_{LI} is predicted to peak when the projectile has a velocity equal to 0.3 times the velocity of the atomic electron. Experimental values of σ_{LII}/σ_{LI}, in agreement with Born predictions, peak at a velocity significantly lower than that predicted by BEA calculations. By transforming to coordinate space in an approximate way, predictions for the impact-parameter dependence are made. In the 2s case, the ionization probability has a pronounced local minimum for impact parameters near half the atomic radius, corresponding to a node in the 2s wave function. The ionization probabilities for arbitrary charged particles on arbitrary targets may be easily found by applying scaling laws to values tabulated over a wide range of projectile velocities. (auth)

25214 VARIATIONAL FORMULATION OF THE COUPLED-STATE IMPACT-PARAMETER METHOD. Shakeshaft, R.; Spruch, L. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. A 10: No. 1, 92-101 (July 1974).

In the coupled-state impact-parameter method the exact impact-parameter wave function is approximated by a trial impact-parameter wave function which is a finite linear combination of N basis vectors with time-dependent coefficients. In the standard approach the coefficients are determined by solving the equations obtained by projecting the impact-parameter Schrödinger equation with the exact wave function replaced by the trial wave function onto the N basis vectors which define the trial wave function. It is well known that this method gives variational estimates of the transition amplitudes if the basis vectors represent physical states. However, if in proton-hydrogen-atom scattering Sturmian basis vectors, which are for the most part nonphysical basis vectors, are used, the method is not variational. In this paper it is shown that if Sturmian basis vectors are used the method can be made variational by projecting the Schrödinger equation with the exact wave function replaced by the trial wave function onto the physical basis vectors of interest rather than onto the Sturmi basis vectors; the resultant equations are no more difficult to solve than the standard equations. It is also shown that useful variational bounds on the error of the estimate of a transition amplitude exist only if the trial wave function is expanded in terms of a physical basis set. (auth)

25215 DECOMPOSITION OF K AND T MATRICES FOR INELASTIC SCATTERING USING VARIATIONAL PRINCIPLES. Conn, R. (Department of Nuclear Engineering, The University of Wisconsin, Madison, Wisconsin 53706); Rabitz, H. J. Chem. Phys. 61: No. 2, 600-608 (15 July 1974).

A family of related approximate equations for K and T matrices applicable to inelastic scattering are derived from a variational principle using operator decompositions and projection operators. These approximations utilize the computational simplicity of first and second Born integrals but have the character of a resummed series such as to extend the usefulness of perturbation theory to stronger interactions and to provide information on multiquanta transitions. The approximations can be viewed as a reorganization of perturbation theory information to yield high-order nonperturbative results. The size of the matrices that enter the decomposition formulation is controlled by the states included in the projection operator. Coupling between these states is included to all orders and is not restricted to transitions between states coupled directly by the potential. The remaining degrees of freedom are treated in a renormalized Born approximation. The formulations can be developed for K or T, either fully off-shell, half off-shell, or fully on-shell, and the final approximations are rational in the potential strength. The approximations to the K matrix are Hermitian so that the resulting S matrix is unitary. (auth)

25216 ASSOCIATIVE AND REARRANGEMENT IONIZATION IN COLLISIONS OF METASTABLE HELIUM WITH H_2. Neynaber, R.H.; Magnuson, G.D. (Intelcom Rad Tech, San Diego, California 92138). J. Chem. Phys. 61: No. 2, 749-750 (15 July 1974).

A crossed beam system is used to measure relative and absolute cross sections for the exothermic, associative ionization reaction $He^* + H_2 \rightarrow HeH_2^+ + e$, where He^* represents either $He(2^1S)$ or $He(2^3S)$. (AIP)

25217 MEASUREMENT OF RESONANCES IN ATOMIC OXYGEN BY ELECTRON TRANSMISSION SPECTROSCOPY. Spence, D.; Chupka, W.A. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. A 10: No. 1, 71-73 (July 1974).

We present the first observations of resonant states in atomic oxygen using an electron-impact technique. We verify the existence of several doublet resonant states located previously by other techniques, and observe for the first time resonant states whose multiplicity is different from that of the ground state of O. To one such state located at 8.80 eV we assign the configuration $[2p^3(^4S)3s^2(^4S)]$ and to another at 14.06 eV we assign the configuration $[2p^3(^2D)3p^2]$. (auth)

25218 SINGLET e-H SCATTERING AT INTERMEDIATE ENERGIES. Rescigno, T.N.; Reinhardt, W.P. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. A 10: No. 1, 158-167 (July 1974).

Using Fredholm techniques employing only square-integrable basis functions, elastic s- and p-wave singlet electron-hydrogen-atom cross sections are calculated for the energy range 10-27 eV, that is, at energies where a continuum of open channels is present. The s and p

amplitudes are combined with higher partial-wave amplitudes taken from earlier close-coupling results,to give singlet e-H elastic angular distributions at and above the ionization threshold. (auth)

25219 ELECTRON-IMPACT EXCITATION OF THE Ba^+ ION. Crandall, D.H.; Taylor, P.O.; Dunn, G.H. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80302). Phys. Rev. A 10: No. 1, 141-157 (July 1974).

Crossed beams of Ba^+ and electrons were used to measure the absolute emission cross sections for the Ba^+ lines, 455.4, 493.4, 490.0, and 413.1+416.6 nm. Polarization fractions of the light were also measured. The data were analyzed to extract level excitation cross sections. The excitation cross section for the 6 $^2P_{3/2}$ level has a value 34.7×10^{-16} cm^2 at the 2.72-eV threshold, shows marked structure in the 3-10-eV interval, and decreases to 1.71×10^{-16} cm^2 at 747 eV. The polarization fraction for the 455.4-nm light exhibits pronounced oscillatory structure in the interval 3-7 eV. Excitation cross section for the 6 $^2P_{1/2}$, 7 $^2{}_{1/2}$, and 6 $^2D_{3/2+5/2}$ levels have values at threshold of 20.0×10^{-16}, 5.4×10^{-16}, and 4.3×10^{-16} cm^2, respectively. Total uncertainties at a "high-confidence level" are about $\pm$10% for the 6 $^2P_{1/2}$ and 6 $^2P_{3/2}$ cross sections. Uncertainties range around $\pm$30% for the 7 $^2S_{1/2}$ cross section and $\pm$20% for the 6 $^2D_{3/2+5/2}$. Measurements for the 6 ^2P cross sections agree at high energies with the Coulomb distorted-wave calculation of Sheorey and Burgess. Measurements for the 6 $^2P_{3/2}$ level are in quite good agreement with the measurements of Bacon and Hooper and of Pace and Hooper for energies 6 to 100 eV. However, the Pace and Hooper points at 3 and 4 eV are nearly twice the present values. Signals due to excitation of metastable 5 ^2D ions in the ion beam were observed, and estimates could be made of the cross section for excitation from this state to the final states above. Cross sections at threshold were estimated to be 13.4×10^{-16} cm$^2\pm$34%, 9.8×10^{-16} cm$^2\pm$28%, 7.4×10^{-16} cm$^2\pm$100%, 6.9×10^{-16} cm$^2\pm$27% for excitation from the 5 ^2D levels to the 6 $^2P_{3/2}$, 6 $^2P_{1/2}$, 7 $^2S_{1/2}$, and 6 $^2D_{5/2+3/2}$ levels, respectively. The rate coefficients for excitation of 6 $^2P_{3/2}$ calculated from the data are in reasonable agreement with the measurements of Hinnov et al. (auth)

25220 OBSERVATION OF Ne^+ TO Ne^{8+} K x RAYS FOLLOWING $O^{5,6,7,8+}$ BOMBARDMENT. Matthews, D.L.; Johnson, B.M.; Moore, C.F. (Center for Nuclear Studies, The University of Texas, Austin, Texas 78712). Phys. Rev. A 10: No. 1, 451-453 (July 1974).

The Ne K x-ray spectrum following bombardment by 30-MeV O^{5+} and 35-MeV O^{6+}, O^{7+}, and O^{8+} beams has been resolved into nine lines corresponding to KL^0 through KL^7 transitions. Using a curved-crystal spectrometer, relative intensities for the previously unresolved KL^0, KL^1, and KL^2 transitions have been extracted despite the overlap of the H-like oxygen-beam x rays. For O^{5+} and O^{7+} bombardment, the measured relative intensities of the remaining lines disagree with a previous measurement. (auth)

25221 MOLECULAR-ORBITAL K X-RAY FORMATION IN HEAVY-ION COLLISIONS. Meyerhof, W.E.; Saylor, T.K.; Lazarus, S.M.; Little, A.; Triplett, B.B. (Department of Physics, Stanford University, Stanford, California 94305); Chase Jr., L.F.; Anholt, R. Phys. Rev. Lett. 32: No. 23, 1279-1282 (10 June 1974).

In order to complete the identification of molecular-orbital K x-ray spectra, we have worked out the expected spectral yields and compared them with experimental spectra produced by 30- and 60-MeV Br and 82-MeV I beams. Independently, we have determined the dominant mechanism of molecular-orbital K x-ray production in 30-MeV Br+Br collisions by diluting the Br density in a solid target. (auth)

25222 MORSE OSCILLATOR WAVEFUNCTIONS IN HIGH ENERGY SCATTERING CALCULATIONS. Garbarino, J.R.; Wartell, M.A. (Department of Chemistry, Metropolitan State College, Denver, Colorado 80204). J. Chem. Phys. 61: No. 2, 743-744 (15 July 1974).

We compare the results of scattering calculations using Morse oscillator wavefunctions with those made using harmonic oscillator wavefunctions. He scattering from H_2, HD, and HT is considered. (AIP)

25223 ELECTRON-MOLECULE SCATTERING AND MOLECULAR PHOTOIONIZATION USING THE MULTIPLE-SCATTERING METHOD. Dill, D. (Department of Chemistry, Boston University, Boston, Massachusetts 02215); Dehmer, J.L. J. Chem. Phys. 61: No. 2, 692-699 (15 July 1974).

We adapt the multiple-scattering method to treat unbound electronic states of molecules in the independent electron approximation. An inhomogeneous linear system is derived whose solution yields the K matrix for the electron-molecule interaction. Using the K matrix, we derive continuum electronic wavefunctions by imposing boundary conditions corresponding to electron-molecule scattering and molecular photoionization, i.e., the wavefunctions satisfy the so-called outgoing-wave and incoming-wave normalization, respectively. These wavefunctions are then used to obtain expressions for elastic scattering and photoionization differential cross sections. (auth)

25224 MODIFIED CLASSICAL S MATRIX FOR TUNNELING IN THE COLLINEAR $H+H_2$ REACTION. Hornstein, S.M.; Miller, W.H. (Department of Chemistry, University of California, Berkeley, California 94720). J. Chem. Phys. 61: No. 2, 745-746 (15 July 1974).

A classical S-matrix method has been previously used for treating tunneling in the collinear $H+H_2$ reaction system. A modification of this procedure is presented that gives better agreement with purely quantum mechanical results for the same system. (AIP)

25225 ION CYCLOTRON RESONANCE SPECTROSCOPY. Hartmann, H.; Lebert, K. H.; Wanczek, K. P. (Frankfurt Univ. (F. R. Germany). Inst fuer Physikalische Chemie). Fortschr. Chem. Forsch.; No. 43, 57-115(1973).

4 figs.; 7 tabs.; 264 refs.

The basic principles of ion cyclotron resonance (ICR) are explained, its practical realization in an ICR spectrometer is described in detail, and the different techniques that have been developed are explained. Some remarks about the information conveyed by ICR signals are added to explain the difference between ICR spectrometry and conventional mass spectrometry in some important respects. Previously reported results both in description and in tables of data on ion-molecule reactions as observed with ICR techniques are summarized. Ion-molecule reactions of hydrogen and deuterium and small molecules of atmospheric interest, of hydrocarbon (deuterated), structure determination of deuterated compounds, and thermal energy rate constants determined by ICR spectroscopy are given. A very complete bibliography of publications dealing with ICR is given. (GE)

25226 END-POINT ENERGY VARIATIONS IN THE NONCHARACTERISTIC RADIATION PRODUCED BY S, Cl, Ar, K, Ca, AND Ti BOMBARDMENT OF Si. Bissinger, G. (Rutgers University, New Brunswick, New Jersy 08903); Feldman, L.C. Phys. Rev. Lett. 33: No. 1, 1-4 (1 July 1974).

The noncharacteristic radiation observed in heavy-ion bombardment of Si was investigated with 200-keV ^{32}S, $^{35,37}Cl$, ^{40}Ar, $^{39,41}K$, ^{40}Ca, and ^{48}Ti projectiles ($16 \leq Z \leq 22$) on Si. The high-energy tail of the noncharacteristic radiation is observed to shift to higher energies as projectile Z is increased. The observed end-point energy shifts are in agreement with the interpretation that the radiation arises from the radiative decay of a projectile 2p vacancy in the quasimolecule formed by the projectile and the target atom during the collision. (auth)

25227 MECHANISMS FOR ELECTRON PRODUCTION IN 30-MeV $O^{n+} + O_2$ COLLISIONS. Stolterfoht, N.; Schneider, D. (Hahn-Meitner-Institut für Kernforschung Berlin GmbH, Berlin-West 39, Germany); Burch, D.; Wieman, H.; Risley, J.S. Phys. Rev. Lett. 33: No. 2, 59-62 (8 July 1974).

Absolute cross sections for electron emission in the complete energy and angular ranges were measured for 30-MeV $O^{n+} + O_2$ collisions at incident charge states of $n=4$ to 8. Rises in inner- and outer-shell ionization of the target are studied for increasing n. Electrons ejected from the outer shell of the projectile are found to be very intense at forward emission angles θ. Auger electrons from the projectile are observed at $\theta < 42°$ for n as large as 6. (auth)

25228 TWO-CENTER THOMAS-FERMI MODEL FOR ADIABATIC ION-ATOM COLLISONS. Eichler, J.; Wille, U. (Hahn-Meitner-Institut für Kernforschung Berlin GmbH, Bereich Kern- und Strahlenphysik, Berlin, West Germany, and Freie Universität Berlin, Fachbereich Physik, Berlin, West Germany). Phys. Rev. Lett. 33: No. 2, 56-59 (8 July 1974).

We propose a two-center model for the description of ion-atom collisions proceeding via a quasimolecular (adiabatic) mechanism. The electronic potential of the model is given by a superposition of modified atomic Thomas-Fermi potentials, each centered about one of the colliding nuclei. Molecular correlation diagrams calculated for the Ne-Ne system show good agreement with results from molecular-orbit Hartree-Fock calculations. (auth)

25229 AUTODETACHING STATES IN I^-. Cunningham, D.L.; Edwards, A.K. (Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30602). Phys. Rev. Lett. 32: No. 17, 915-917 (29 Apr 1974).

Collisional excitation of negative iodine ions produces a group of peaks between 5 and 8 eV in the detached-electron spectrum. The autodetaching states decaying into these peaks appear to have dominant configurations of the form (I^+ core)6s6l. No structure is apparent at lower electron energies. (auth)

25230 EXCITATION OF METASTABLE LEVELS IN np^2 CONFIGURATIONS. Bokhan, P.A.; Kiyashkina, G.S. Opt. Spectrosc. (USSR) 36: No. 3, 262-264 (Mar 1974).

Excitation of the metastable levels of tin and lead is investigated. It is shown that the decrease in population of the metastable levels which is observed with increasing current must be associated with ionization of the substance, rather than with deexcitation by electrons. When the

concentration of the substance is high, the fraction of ions is very small and the population of the metastable levels is constant over a wide range of current. This makes it possible to introduce the term "temperature of the metastable level." In a discharge in a mixture of lead vapor+noble gas the temperature of all four metastable levels T_{ms} is the same; its absolute value is less than 2 eV. It is shown that T_{ms} can be close to the electron temperature. As the vapor pressure of lead increases, T_{ms} rapidly decreases and precisely this fact explains the sudden decrease in the intensity of the forbidden lines with increasing pressure. Previously this was explained in terms of deexcitation of the metastable levels in atom–atom collisions. (auth)

25231 CROSS SECTIONS FOR ELECTRON–IMPACT EXCITATION AND MIXING OF THE $6^3P_{0,1,2}$ LEVELS OF A MERCURY ATOM. Penkin, N.P.; Redko, T.P. Opt. Spectrosc. (USSR) 36: No. 3, 258-261 (Mar 1974).

A positive discharge column in mercury vapor is investigated by optical and probe methods. Its aftergiow is studied in the concentration range (0.7–15) $\times 10^{14}$ cm^{-3} of normal atoms and with use of discharge currents from 10 to 600 mA. From the equations of stationarity for the population of the $6^3P_{0,1,2}$ levels, the cross sections for excitation of these levels by electron impact are determined at the maximum of the excitation function (2.2×10^{-16}, 1.3×10^{-16} and 0.6×10^{-16} cm^2 for the 6^3P_2, 6^3P_1 and 6^3P_0 levels respectively). From the decay rate of atoms in the $6^3P_{0,1,2}$ states, measured in the afterglow, the cross sections for transitions 6^3P_0–6^3P_1 and 6^3P_1–6^3P_2 are found for collisions of excited atoms with electrons (25×10^{16} and 14×10^{-16} cm^2). (auth)

25232 COMPARISON OF THEORETICAL CO^+–CO CHARGE–TRANSFER CROSS SECTIONS WITH RECENT MEASUREMENTS AT LOW KINETIC ENERGIES. Cosby, P.C.; Moran, T.F.; Flannery, M.R. (Georgia Institute of Technology, Atlanta, Georgia 30332). J. Chem. Phys. 61: No. 3, 1259-1260 (1 Aug 1974).

Recently, cross sections for CO^+–CO charge transfer have been measured in the range 0.1–10 eV. In this paper, calculations of these cross sections by a multistate impact parameter treatment have been extended into this range. The computed cross sections exhibit satisfactory agreement with the experimental data over the entire range. (AIP)

25233 COLLISION INDUCED DISSOCIATION IN THE He–H_2 COLLISION SYSTEM. Garbarino, J.R.; Wartell, M.A. (Department of Chemistry, Metropolitan State College, Denver, Colorado 80202); Malerich, C.J. J. Chem. Phys. 61: No. 3, 1253-1254 (1 Aug 1974).

Collisional dissociation probabilities and cross sections for the He–H_2 collision system have been calculated in the relative energy range 30–50 eV using the sudden approximation for vibrational excitation. The results are compared with experimental studies. (AIP)

25234 ELECTRON EXCITATION OF THE (0,0) SECOND POSITIVE BAND OF NITROGEN FROM THRESHOLD TO 1000 eV. Imami, M.; Borst, W.L. (Department of Physics and Astronomy, Southern Illinois University at Carbondale, Carbondale, Illinois 62901). J. Chem. Phys. 61: No. 3, 1115-1117 (1 Aug 1974).

The excitation of the 2PG(0,0) band of nitrogen (λ3371) by electron impact was studied from threshold (11 eV) to 1000 eV. In view of the serious discrepancies in the existing cross section measurements for this band at higher energies (>30 eV), the effects due to high pressures and secondary electrons were carefully studied. Secondary electron effects were monitored by scanning the luminosity profiles in the collision chamber with a moveable optical detector assembly. The signal count rates were also monitored as a function of pressure. As a result of these checks, the present measurements were carried out at pressures in the 10^{-5} torr range. In order to increase the signal count rates at these pressures and high electron energies, the collision chamber was given the shape of an ellipsoid with highly polished interior surfaces. The electron gun was of the electrostatically focussed type. The signal count rates were compared with those from the 1NG(0,0) band at λ3914, for which the cross section is well established. As a result, it was found that the cross section for the 2PG(0,0) band decreases rapidly with increasing energy, but not rapidly enough to yield the expected E^{-3} dependence. The cross section has a value of 1.3×10^{-19} cm^2 at 100 eV, which is about an order of magnitude smaller than most existing measurements. (auth)

25235 IMPROVED SOLUTIONS TO THE EQUATION OF MOTION IN THE UNIFORM WKB THEORY FOR TWO–CHANNEL PROBLEMS. Cho, U.; Eu, B.C. (Department of Chemistry, McGill University, Montreal, Quebec, Canada H3C 3G1). J. Chem. Phys. 61: No. 3, 1172-1179 (1 Aug 1974).

The equation of motion in the uniform WKB theory for a two-channel problem is reinvestigated with a view to obtain improved approximate solutions that would perform better than the first order Magnus approximation solution previously used in the analysis of two-channel inelastic collision problems. We have developed two approximate solutions and investigated their variants in the paper. The two main improved approximate solutions are obtained by properly resumming the Magnus expansion in a novel way and also by appropriately modifying the equation of motion such that the Magnus approximation used on it would not damage the accuracy of the solution thus obtained. The solutions obtained give rise to transition probabilities well comparable over a wide range of the coupling constant with those obtained by the numerical solution of the coupled Schrödinger equations. (auth)

25236 SEMICLASSICAL TREATMENT OF VIBRATIONAL–TRANSLATIONAL ENERGY TRANSFER IN THE NEAR–ADIABATIC APPROXIMATION. Cady, W.A. (Department of Chemistry, Indiana–Purdue University at Indianapolis, Indianapolis, Indiana 46206). J. Chem. Phys. 61: No. 3, 1214-1220 (1 Aug 1974).

Vibrational–translational energy transfer is examined in the near–adiabatic (or perturbed stationary states) approximation by treating the relative motion classically. The value of this approach is demonstrated by comparing the results obtained here with the exact results as well as with the results of other approximate treatments. The regions of validity of the approximation employed are discussed and are shown to be essentially the same as those indicated by the totally classical treatment of Attermeyer and Marcus. Best results are obtained for the lower energy, less impulsive collisions. An analytic expression is derived to permit quite accurate results to be calculated quickly and easily. (auth)

25237 ABSOLUTE DIFFERENTIAL CROSS SECTIONS OF ELECTRONS ELASTICALLY SCATTERED BY THE RARE GASES. I. SMALL ANGLE SCATTERING BETWEEN 200 AND 700 eV. Bromberg, J.P. (Department of Chemistry and Mellon Institute, Carnegie–Mellon University, Pittsburgh, Pennsylvania 15213). J. Chem. Phys. 61: No. 3, 963-969 (1 Aug 1974).

Absolute differential cross sections of electrons scattered by the rare gases He, Ne, Ar, Kr, and Xe were measured between 2° and 30° at 200, 300, 400, 500, and 700 eV. The results for He are compared with experimental and theoretical results from other laboratories, and serious discrepancies are found to exist between the data reported by various laboratories. (auth)

25238 EXCITATION AND IONIZATION OF GASES BY FISSION FRAGMENTS. Walters, R. A. Gainesville, FL; University of Florida (1973). 325p. University Microfilms Order No. 74-9568. Thesis (Ph.D.).

The excitation and ionization produced by fission fragments was investigated to identify basic mechanisms that could be applied to direct nuclear pumping or enhancement of gas lasers. A cylindrical ^{235}U foil and its axial electrodes were placed in a vacuum chamber which was capable of transmission of fluorescence to its exterior from 2000 Å to 8000 Å. The chamber was filled with argon, helium, or carbon tetrafluoride at various pressures and immersed in a thermal neutron flux of 3.8×10^{11} n/cm^2-sec. The spectrum obtained from this excitation was qualitatively similar to a glow discharge for argon and helium except for the presence of excited ion species of He II and Ar III. Pressure-dependent relative intensity and excited-state density data provide information on state and species kinetics. Boltzmann analysis of the excited states supplied a temperature for each species where the correlation coefficients of the fit lines indicate that the plasmas are typical nonequilibrium cascade systems. Electron densities around 10^{10} e$^-$/cm^3 and Maxwellian temperature values for the collected electrons were obtained from the recombination region I–V characteristics. In the ion chamber region of the I–V characteristics, line emission increased as an exponential function of field strength. A neutron detector was developed for the liquid metal fast breeder reactor by using optical transmission from the reactor core of electric field-modulated emission from fission fragment excitation. Because of the excellent spectral output from Ar II, a nuclear pumped argon ion optical cavity was constructed. The effect of mixed radiation from the reactor on a glow discharge was studied. (RWR)

25239 POSITRONIUM SCATTERING BY HYDROGEN AND HELIUM ATOMS. Page, B. A. P. London, Ont.; Univ. of Western Ontario (1973). vp. National Library of Canada, Ottawa. Thesis (Ph. D.).

It is demonstrated that the Kohn variational principle gives results that are difficult to relate to the scattering properties of this system. The use of this principle involved selecting a suitable trial wave function containing linear and nonlinear parameters. The trial wave function was inserted in an integral expression for the scattering length and the parameters determined by applying the variational technique. Difficulties were encountered that manifested themselves as irregular behavior of the scattering length values. This irregular behavior appears to be primarily due to the use of an inexact helium ground state wave function in the calculations. Modifications of various procedures suggested by Peterkop and Rabik (1971) and by Houston and Drachman (1971a, 1971b) were applied to this system. The trial wave function obtained from this method was then used to calculate the effective charge (related to the annihilation rate) of

the ortho-positronium-helium system. All the numerical calculations were carried out using the DEC-PDP10 and the CDC-CYBER 73 (originally of the CDC6400 series) at the University of Western Ontario. Due to the erratic behavior of the Kohn scattering length values a rigorous interpretation of the numerical results could not be made. Interpretations of the numerical results based on nonrigorous criteria gave values of the scattering length ranging from $2.33a_0$ to $1.0a_0$ with corresponding singlet effective charges of 0.011 and 0.12 respectively. It is felt that more accurate helium ground state wave functions must be used in order to obtain better estimates of the scattering length. A similar calculation was performed on the zero-energy scattering of a positronium atom by a hydrogen atom. The scattering length was estimated to be $2.474a_0$ for the anti-symmetric case. Irregular behavior of the scattering length values prevented reliable estimates to be carried out for the symmetric case. This irregular behavior is presumably due to the fact that the normal Kohn method does not provide a bound of the scattering length values obtained since in this case the projectile and target form a composite bound state. (Diss. Abstr. Int., B)

25240 INVESTIGATION OF THE EXCITATION OF STRONTIUM ATOMS BY ELECTRON IMPACT FROM METASTABLE STATES. Shafran'osh, I. I.; Aleksakhin, I. S.; Zapesochnyi, I. P. (Uzhgorod State Univ., USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 161-162(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 271-274(5 Mar 1974).

The method of intersecting electron and atom beams was used to perform experiments on stepwise excitation of strontium atoms from metastable states. The excited atoms were produced by passage of the atom beam through a pulsed gas-discharge chamber. The excitation of four triplet levels from the ground state and excited states. Using as an example the comparison of the excitation functions of the transition $5^3P_2-6^3D_2$ from the ground and metastable states, it is shown that their behavior differs significantly in character. So large a difference between the shapes of the curves is attributed to the fact that the excitation of the investigated level starts from initial states having different multiplicities. (auth)

25241 FORM OF THE TENSOR OF SPONTANEOUS RAMAN SCATTERING. Aleksandrov, I. V.; Bobovich, Ya. S.; Maslov, V. G. JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 157-159 (5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 264-268(5 Mar 1974).

By measuring simultaneously the degree of depolarization and the inversion coefficients in spontaneous Raman scattering spectra, it is shown that the spontaneous Raman scattering tensor responsible for some of the oscillations is asymmetrical. The role of the resonance conditions for the excitation spectra and of the mixing of the electron and nuclear motions in this effect is explained. The possibilities offered by spontaneous Raman scattering in vibronic spectroscopy are demonstrated. (auth)

25242 X-RAY SPECTROSCOPIC STUDY OF HEAVY ION-ATOM COLLISIONS. Kamada, H.; Tamura, T. (Tokyo Univ.). pp 541-552 of Proceedings of the Sixth International Conference on X-Ray Optics and Microanalysis. Shinoda, G. (ed.). Osaka; University of Tokyo Press (1972).

Tokyo (5 Sep 1971). Sixth international conference on x-ray optics and microanalysis.

Experimental results are presented on the excitation of K and L x-rays at the energy from 0.1 to 1.5 keV by the bombardment of H^+, C^+, N^+, O^+, Ne^+, and Ar^+ ions in the energy range of 20 to 500 keV. The ions were obtained by using a 200 keV ions accelerator with PIG ion source. The x-rays were detected at 45° take-off angle with a gas-flow proportional counter. The measurement by nondispersion method and that with a flat-crystal diffraction spectrometer were carried out alternately. The ionization cross section of carbon K-shell was obtained for various ions. The cross sections in proton bombardment are in general agreement with theory. The data on heavy ions show larger cross section than the theory. The results of the cross section measurement of beryllium K-shell were similar to those for the carbon K-shell. The L-shell ionization cross section for various elements was quite similar to that for the K-shell ionization. The experimental results on the ionization cross section in heavy ion-atom collision may be understood within the framework of Fano–Lichten model. The spectra of heavy ion-induced x-ray measured with a diffraction spectrometer are shown. The observed spectra of heavy ion-induced C K x-ray show asymmetric profile, shift of peaks to higher energy side, and broadening in fwhm (full width at half maximum). In heavy ion-induced L x-ray spectra, two peaks appear corresponding to $L\alpha_{1,2}$ and $L\beta_1$. They did not show any shift, but the relative intensity of $L\beta_1$ line to $L\alpha_{1,2}$ line is very high in contrast with the spectra by protons or electrons. The spectra of heavy ion-induced x-ray change markedly, depending upon projectile and its bombarding energy. (auth)

25243 POLARIZATION OF THE LIGHT FROM THE 3^1P-2^1S TRANSITION IN PROTON BEAM EXCITED HELIUM. Weinhous, M. S. Durham, NH; Univ. of New Hampshire (1974). 206p. University Microfilms Order No. 74-17,417.

Thesis (Ph. D.).

Measurements of the polarization of the light from the 3^1P-2^1S (λ 5016 Å) transition in proton beam excited helium have shown both a proton beam energy and helium target gas pressure dependence. Results for the linear polarization fraction (at right angles to the proton beam and at 0.2 mtorr He target pressure) range from +2.6% at 100 keV proton energy to −5.5% at 450 keV. The zero crossover occurs at approximately 225 keV. This is in good agreement with other experimental work in the field, but in poor agreement with theoretical predictions. The other experimental workers have used 0.2 mtorr as their lowest He target gas pressure, while in this work measurements have been made at He target gas pressures as low as 0.01 mtorr. The results have shown that the linear polarization fraction is still pressure dependent at 0.01 mtorr. Also a pressure dependence of photons per proton per He target atom was found. It was then concluded that experimental determinations of the linear polarization fraction have not yet been made under conditions which allow for strict comparison with theoretical predictions. (Diss. Abstr. Int.; B)

Atomic Theory

Refer also to abstract 25613.

25244 (CONF-740711–2) STRUCTURE INFORMATION FROM ATOMIC-BEAM MAGNETIC-RESONANCE STUDIES OF MANY-ELECTRON ATOMS. Childs, W. J. (Argonne National Lab., Ill. (USA)). 1974. 16p. Dep. NTIS $4.00.

From 4th international conference on atomic physics; Heidelberg, F. R. Germany (22 Jul 1974).

A very brief review is given of the role that atomic-beam magnetic resonance has played in the recent development of the understanding of atomic structure. A few examples of the different types of contributions such research can make are given. The hyperfine structure and configuration interaction are considered. (JFP)

25245 (LBL-2960) SUMMARY OF THE INTERNATIONAL CONFERENCE ON HYPERFINE INTERACTIONS STUDIED BY NUCLEAR REACTIONS AND DECAY. Shirley, D. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1974. Contract W-7405-eng-48. 19p. (CONF-740633-2). Dep. NTIS $4.00.

From international conference on hyperfine interactions studied in nuclear reactions and decay; Uppsala, Sweden (10 Jun 1974).

The conference covered the calculation of hyperfine fields in atomic systems, recoil into vacuum, gas, and solids, radiation damage studies on implanted sources, nuclear moments, solid state studies, and relaxation. (JFP)

25246 (SAND-74-6015) THEORY OF NON-ADIABATIC CHEMICAL PROCESSES. London, F. Translated by C. A. Henkel from Z. Phys.; 74: 143-174(1932). 53p. Dep. NTIS $5.75.

The statistical theory of atomic forces, so far treated almost exclusively by the methods of quantum mechanics, requires the supplement of a chemical reaction dynamics. The variously applied collision formulations do not appear to be adequate to the treatment of chemical processes. A dynamic theory is developed for the simplest type of bimolecular reactions, which readily expresses the problem as viewed by chemistry and is illustrated in the discussion of simple examples. A perturbation procedure is introduced which converges both for large and small collision velocities, and which permits a relatively simple approximation to be obtained for the reaction rate of nonadiabatic processes. On the other hand, this theory deals quantitatively with the merger into adiabatic reactions, at low velocities or widely separated potential levels. It thus provides a conditional justification for the application of potential theory concepts to chemical processes, while simultaneously setting the limits for such an idealization. (auth)

25247 ON SOLUTIONS TO THE HARTREE–FOCK PROBLEM FOR ATOMS AND MOLECULES. Lieb, E.H. (Departments of Mathematics and Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Simon, B. J. Chem. Phys. 61: No. 2, 735-736 (15 July 1974).

For a molecule of total nuclear charge Z and N electrons, there exists a determinantal wavefunction that actually minimizes the energy

when $Z > N-1$. These N orthonormal functions satisfy the Hartree–Fock equation and are the lowest energy eigenfunctions of that equation. (auth)

25248 MAGNETIC DIPOLE AND ONE ELECTRON SPIN–ORBIT INTEGRALS OVER SLATER FUNCTIONS. Matcha, R.L.; Anderson, J. (Department of Chemistry, University of Houston, Houston, Texas 77004). J. Chem. Phys. 61: No. 3, 1252-1252 (1 Aug 1974)

By utilizing methods developed in a series of papers by Matcha and co-workers, it is shown that it is possible to derive compact expressions for integrals involving the magnetic dipole operator, $m = r \times \nabla$. (AIP)

25249 FREE-ELECTRON GREEN FUNCTION OF A MULTIPLE SCATTERING MOLECULAR MODEL. Tomasek, M. (Inst. of Physical Chemistry, Prague); Mikolas, V. Czech. J. Phys.; 24: No. 8, 878-884(1974).

An explicit form of bicentric expansions of the free-electron Green's function of a multiple scattering model of molecules was as obtained in a straightforward way as a result of a compact and simple derivation of certain addition formulas relating spherical Bessel, Neumann, and Hankel functions defined with respect to different centers of the above-mentioned molecular model. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

25250 PRESSURE DRAG COEFFICIENT FOR A CYLINDRICAL OBSTACLE IN LIQUID MAGNETODYNAMICS. Vives, C. Compt. Rend., Ser. B; 278: No. 12, 501-504(18 Mar 1974). (In French).

Experimental results are presented on the pressure distribution developed around a cylinder positioned transverse to the mean direction of the flow of an electrically conducting liquid and in the presence of a magnetic field. The variations occurring in the pressure drag coefficients are given for insulating and electrically conducting cylinders for the case when $635 \leq R_e \leq 6350$ and $0 \leq M \leq 160$, the magnetic induction being either perpendicular or parallel to the axis of symmetry of the obstacle. (FR)

25251 MAGNETOHYDRODYNAMIC DUCT FLOW. Izawa, H. S. Lincoln, NE; Univ. of Nebraska (1973). 204p. University Microfilms Order No. 74-12,991.

Thesis (Ph. D.).

This study of magnetohydrodynamic duct flow is divided into three sections: magnetohydrodynamic entrance flow through the ducts of parallel plates, straight duct flow by Kantorovich's variational method, and duct flow with sectorial cross-section with an applied current at the center. In the magnetohydrodynamic entrance flow, the non-linear inertia term of the governing equation is linearized by using two undetermined functions $-\epsilon(x)$ and $\Lambda(x)$. Numerical calculations are carried out for symmetric and asymmetric flow configurations which consist of one or more jets, with Hartmann numbers from 0 to 8. The study of straight duct flow by Kantorovich's variational method is considered. Solutions are obtained by extremizing a certain integral with the help of a trial function of the form $(\eta^2 - \phi^2)f(\xi)$. Duct flow with sectorial cross-section with an applied current at the center is considered. The problem is solved by the use of the finite Fourier transform. Numerical calculations are carried out for various sectorial angles and Hartmann numbers from 0 to 20. For the large Hartmann numbers, backflow regions are observed to exist. Calculations also include cross-sections of various inner wall radii. (Diss. Abstr. Int., B)

PHYSICS (HIGH-ENERGY)

25252 (RL-74-038) PROCEEDINGS OF THE 1973 SCHOOL FOR YOUNG HIGH ENERGY PHYSICISTS, JULY 15–27, 1973. Muirhead, H. (ed.). (Science Research Council, Chilton (UK). Rutherford Lab.). Mar 1974. 285p. Dep. NTIS (US Sales Only) $17.25.

Four lectures and four seminars are included; a separate abstract is prepared for each. (LBS)

For abstracts of individual papers see: 24085, 24250, 25310, 25322, 25340, 25423, 25424, and 25798.

Particle Interactions and Properties (Experimental)

Refer also to abstract 26138.

25253 (NP-20125) ANNUAL REPORT, 1973. (European Organization for Nuclear Research, Geneva (Switzerland)). 1973. 235p. Dep. NTIS (US Sales Only) $14.75.

The report is divided into two sections entitled Laboratory I: Basic and ISR Programs and Laboratory II: 300-GeV accelerator program. Information concerning internal organization, nuclear physics, theoretical physics, track chambers, data handling, and administration is given; work of the synchrocyclotron machine, proton synchrotron machine, and Intersection Storage Rings divisions is also reported. As is usual with reports in this series, some data are presented, but the report is basically descriptive in nature. Appendices dealing with CERN publications (32 pages), lectures and seminars, training programs, and scientific conferences and schools are also included. (RWR)

25254 (ORO-2504-217A) PROGRESS REPORT, 1973–1974. Technical Report No. 75-007. Snow, G. A. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jul 1974. Contract AT(40-1)-2504. 34p. Dep. NTIS $4.75.

Research on strong interactions in the high energy and resonance regions, threshold production of pions by pions, electromagnetic and weak interactions, and experimental techniques is summarized. A list of publications is included. (auth)

25255 (USIP-74-01) ANNUAL REPORT [ON] PARTICLE PHYSICS. (Stockholm Univ. (Sweden). Fysiska Institutionen). Jan 1974. 66p. Dep. NTIS (US Sales Only) $6.50.

The University of Stockholm research activities carried out during the year 1973 are summarized. Proposals to study π^0 production in 19 GeV/c pp interactions and to study $\bar{p}p$ interactions in the BEBc are described. Results are reported on the 19.2 GeV/c proton-deuteron experiment, high multiplicity reactions, strange particle reactions, antiproton-proton reactions at 9 GeV/c, elastic scattering of π^+ and K^+ mesons on protons at 10 GeV/c, elastic scattering and $\bar{p}p$ annihilation at 6.2 GeV/c. Computer development, development of scanning equipment, and development work for BeBc are also reported. (LBS)

Electromagnetic

25256 (DESY-73/61) INCLUSIVE PHOTOPRODUCTION OF PIONS, KAONS AND PROTONS AT 6 GeV. Burfeindt, H.; Buschhorn, G.; Genzel, H.; Heide, P.; Koetz, U.; Mess, K. H.; Schmueser, P.; Sonne, B.; Vogel, G.; Wtik, B. H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1973. 15p. INIS.

17 figs.; 3 tabs.; 14 refs. With abstract.

The invariant cross sections for inclusive photoproduction of charged pions, kaons and protons have been measured at DESY in the photon fragmentation region at a photon energy of 6 GeV. For a positive ratio x of p(parallel) to p(maximal) in the cm-system the average transverse momentum for $\pi^\pm$ and K^- was found to be roughly 420 MeV/c as compared to an average transverse momentum of about 550 MeV/c for K^+ and protons. The π^+/π^- ratio is close to one at small values of the transverse momentum but increases with increasing transverse momentum. This indicates that scaling is violated at large transverse momenta (or low missing masses). The same general behavior is also observed in the K^+/K^- ratio, although here the ratio is significantly larger than one even at small transverse momenta. The data are also analyzed according to the triple Regge model of inclusive reactions and the effective trajectories have been determined. (GE)

25257 (DESY-74/28) POSSIBLE NUCLEON RESONANCE ADMIXTURE IN THE DEUTERON. Benz, P.; Soeding, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jun 1974. 13p. Dep. NTIS (US Sales Only) $4.00.

Low energy, apparently resonant $p\pi^+$ systems are found to emerge when deuterons are struck by high energy photons. These could be Δ (1236) "spectators" set free from a hypothetical virtual $\Delta\Delta$ state of the deuteron occuring with ~3% probability. The possibility of other interpretations of this observation is also explored. (auth)

25258 PHOTOPRODUCTION OF NEUTRAL PIONS ON HYDROGEN BELOW 500 MeV. P. 4. Combination of the Cross Section Data of all Bonn Experiments of π^0 Photoproduction. Genzel, H.; Hilger, E.; Knop, G.; Kemen, H.; Wedemeyer, R. (Bonn Univ. (F. R. Germany). Physikalisches Inst.). Z. Phys.; 268: No. 1, 43-50(May 1974).

4 figs.; 2 tabs.; 17 refs.

New measurements of the differential cross sections of the reaction $\gamma + p \rightarrow \pi^0 + p$ which were described in Part I and II gave rise to a careful and critical comparison of their results with the data of earlier experiments, in particular with those carried out at Bonn. It was found that after some cuts and minor modifications applied to the older experiments the data of all experiments done at Bonn can be combined to one set. This set of data covers nearly the whole kinematical region from 220 up to 500 MeV. On the basis of this extended set of data a multipole analysis was done by theorists at Bonn. Due to the fact that cross sections at small angles had become available this analysis gave more reliable figures for some of the smaller multipole amplitudes, in particular for the electric dipole amplitude E(o+). (auth)

25259 PHOTOPRODUCTION OF NEUTRAL PIONS ON HYDROGEN BELOW 500 MeV. P. 3. Cross Section Measurements Between the First and the Second Resonance. Genzel, H. (Bonn Univ. (F. R. Germany). Physikalisches Inst.). Z. Phys.; 268: No. 1, 37-41(May 1974).

3 figs.; 2 tabs.; 4 refs.

Differential cross sections of neutral pion photoproduction on hydrogen were measured in the region between the first and the second nucleon resonance at photon energies of 400–500 MeV and were compared with results of an energy-independent multipole analysis. (auth)

25260 PHOTOPRODUCTION OF NEUTRAL PIONS ON HYDROGEN BELOW 500 MeV. P. 2. Cross Section Measurements at Small Pion Angles and Low Proton Energies. Jaeckel, K.; Kaiser, H.; Kemen, H.; Wedemeyer, R.; Weyer, H. J. (Bonn Univ. (F. R. Germany). Physikalisches Inst.). Z. Phys.; 268: No. 1, 27-36(May 1974).

11 figs.; 3 tabs.; 11 refs.

Measurements of differential cross sections of the reaction $\gamma + p \rightarrow \pi^0 + p$ are described. In this experiment which was carried out at the Bonn 500 MeV synchrotron the recoil proton was detected. It was the aim of the experiment to check and to extend the available cross section data towards smaller pion cm angles. In order to overcome the difficulties connected with the corresponding low proton energies a gas target and a time-of-flight telescope were used. Absolute differential cross sections at pion cm angles of 40, 50, 60, and 70° and at photon lab energies between 240 and 380 MeV are reported. (auth)

25261 PHOTOPRODUCTION OF NEUTRAL PIONS ON HYDROGEN BELOW 500 MeV. P. 1. Cross Section Measurements Near the First Resonance at Forward Angles. Hilger, E.; Roegler, H. J.; Simons, L. M.; Tonutti, M. (Bonn Univ. (F. R. Germany). Physikalisches Inst.). Z. Phys.; 268: No. 1, 19-26 (May 1974).

6 figs.; 1 tab.; 12 refs.

At the Bonn 500 MeV electron synchrotron, differential cross sections of the reaction $\gamma + p \rightarrow \pi^0 + p$ were measured in the kinematical region of photon energies between 340 and 420 MeV and pion CM angles from 10 to 70° by means of detecting the two photons from the pion decay by two Cherenkov counters. (auth)

25262 DIRECT ELECTRON PAIR PRODUCTION BY HIGH-ENERGY MUONS. Jain, P.L.; Kazuno, M.; Girard, B. (High Energy Experimental Laboratory, Department of Physics, State University of New York at Buffalo, Buffalo, New York 14214). Phys. Rev. Lett. 32: No. 25, 1460-1463 (24 June 1974).

By following 280.11 m of track length of 15.8-GeV/c negative muons in nuclear emulsion, twenty direct electron pairs were observed. For these pairs we have analyzed (i) the total energy distribution, (ii) the energy partition between the two members, (iii) the angular divergence, (iv) the transverse momentum distribution, and (v) the invariant mass of

the electron pairs. The experimental results are compared with the present theories. (auth)

25263 IMPROVED LIMIT ON PHOTON REST MASS. Hollweg, J.V. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado 80303). Phys. Rev. Lett. 32: No. 17, 961-962 (29 Apr 1974).

Recent observations of Alfvén waves in the interplanetary medium provide an improved upper limit on the photon rest mass. We find a reliable upper limit $\mu \leq 3.6 \times 10^{-11}$ cm^{-1}, $m_{ph} \leq 1.3 \times 10^{-48}$ g, and a stronger, but less certain upper limit $\mu < 3.1 \times 10^{-12}$ cm^{-1}, $m_{ph} < 1.1 \times 10^{-49}$ g. These represent improvements on the heretofore best reliable estimate by 0.5 and 1.5 orders of magnitude, respectively. (auth)

25264 MEASUREMENT OF CHARGED-HADRON MULTIPLICITIES IN DEEP INELASTIC ELECTRON-NEUTRON SCATTERING. Sadoff, A.J. (Physics Department, Ithaca College, Ithaca, New York 14850); Berkelman, K.; Garbincius, P.H.; Gibbard, B.; Klinger, J.S.; Wanderer, P. Phys. Rev. Lett. 32: No. 17, 955-957 (29 Apr 1974).

We report measurements of the charged-hadron multiplicity for electrons scattered by neutrons at momentum transfers up to $Q^2 = 6$ GeV^2, and for s up to 14 GeV^2. The average multiplicity shows little or no Q^2 dependence at fixed s, and except at low s it is consistent with being the same as the multiplicity in electron-proton scattering. (auth)

Weak

25265 (COO-3065-78) MUON-DEUTERON DEEP INELASTIC SCATTERING. Kim, I. J.; Entenberg, A.; Jostlein, H. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy; Columbia Univ., New York (USA). Dept. of Physics; Harvard Univ., Cambridge, Mass. (USA). Dept. of Physics; National Accelerator Lab., Batavia, Ill. (USA)). 1974. 28p. Dep. NTIS $4.50.

Deep inelastic muon-deuteron scattering was measured in the range $0.4 < q^2 < 3.4$ and $1.6 < \nu < 5.6$ GeV. The neutron structure function was extracted, and it was found that it scales in the Bjorken variable $x = 1/\omega$ but that νW_2^n differs significantly from νW_2^p, as also found in e-d scattering. For a quantitative comparison of μ-d and e-d scattering the ratio $r(Q^2) = (\nu W_2)_\mu^d / (\nu W_2)_e^d = N(1 + Q^2/\Lambda^2)^{-2}$ was formed, and the values $N = 0.925 \pm 0.038$ and $1/\Lambda^2 = -0.019 \pm 0.016$ were found. These values of N and $1/\Lambda^2$ are compatible with results obtained from μ-p inelastic scattering. (auth)

25266 (IFVE-SPK-73-17) POSSIBILITY OF INVESTIGATION OF ν_e-SCATTERING BY MEANS OF BUBBLE CHAMBER SKAT. Nikitin, Yu. P.; Rozhnov, G. V.; Volkov, A. A.; Ivanilov, A. A.; Kuznetsov, E. P.; Makeev, V. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 14p. (In Russian). INIS.

The possibility is considered of experimental study of the process ν_μ e-dispersion using a bubble chamber on the neutron beam of the IFVE. Based on the theory of weak interactions with neutral currents, the angles and energy spectra of the electrons in the reaction $\nu_\mu + e \rightarrow \nu_\mu$ were studied with consideration of the neutrino spectrum expected in the IFVE. Direct comparison of these spectra with similar dispersions of electrons in the background process $\nu_e + n \rightarrow e^- + p$ showed the optimum conditions for observing the desired process. (tr-auth)

25267 EXPERIMENTAL REVIEW OF NEUTRINO INDUCED REACTIONS. Nguyen-Khac, U. (Ecole Polytechnique, Paris). J. Phys. (Paris), Colloq.; No. 3, 9-21(1973). (In French).

From centenary congress on the French Physical Society; Vittel, France (28 May 1973).

Only ν_μ and $\bar{\nu}_\mu$ interactions involving the charged leptons μ^- and μ^+ in the final state are analysed in this review. Results obtained from elastic and quasi elastic reactions are compatible with the V-A theory of weak interactions. The analysis of inclusive reactions gives for the ratio of total cross sections $\sigma\bar{\nu}/\sigma\nu$ a value near the physical boundary, $1/3$, allowing a direct comparison with theoretical predictions. (FR)

25268 GAUGE-THEORY HEAVY MUONS: AN EXPERIMENTAL SEARCH. Barish, B.C.; Bartlett, J.F.; Buchholz, D.; Merritt, F.S.; Sciulli, F.J.; Shields, D.; Suter, H. (California Institute of Technology, Pasadena, California 91109); Krafczyk, G. Phys. Rev. Lett. 32: No. 24, 1387-1390 (17 June 1974).

We have observed 1522 neutrino events with a μ^- secondary and 8 events with a μ^+ secondary from a beam consisting mostly of neutrinos. The μ^+ events are consistent in number and kinematic properties with beam contamination by $\bar{\nu}_\mu$. This experiment sees no evidence for production of heavy positively charged leptons. Assuming a coupling constant equal to the universal Fermi constant and a branching ratio to muons B=0.3, our 90% confidence lower limit corresponds to $M_{\gamma^+} \gtrsim 8.4$ GeV/c^2. (auth)

25269 MEASUREMENT OF RATES FOR MUONLESS DEEP INELASTIC NEUTRINO AND ANTINEUTRINO INTERACTIONS. Aubert, B.; Benvenuti, A.; Cline, D.; Ford, W.T.; Imlay, R.; Ling, T.Y.; Mann, A.K.; Messing, F.; Pilcher, J.; Reeder, D.D.; Rubbia, C.; Stefanski, R.; Sulak, L. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 32: No. 25, 1457-1460 (24 June 1974).

Relative rates for deep inelastic neutrino and antineutrino scattering without a final-state muon have been measured. For neutrinos the result is $R^\nu = \sigma(\nu_\mu + \text{nucleon} \rightarrow \nu_\mu + \text{hadrons})/\sigma(\nu_\mu + \text{nucleon} \rightarrow \mu^- + \text{hadrons}) = 0.11 \pm 0.05$. The corresponding ratio for antineutrinos is $R^{\bar{\nu}} = 0.32 \pm 0.09$. (auth)

25270 FURTHER OBSERVATION OF MUONLESS NEUTRINO-INDUCED INELASTIC INTERACTIONS. Aubert, B.; Benvenuti, A.; Cline, D.; Ford, W.T.; Imlay, R.; Ling, T.Y.; Mann, A.K.; Messing, F.; Piccioni, R.L.; Pilcher, J.; Reeder, D.D.; Rubbia, C.; Stefanski, R.; Sulak, L. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 32: No. 25, 1454-1457 (24 June 1974).

We report here additional positive results of a search for muonless neutrino- and antineutrino-induced events using an enriched antineutrino beam and a muon identifier of relatively high geometric detection efficiency. The ratio of muonless to muon event rates is observed to be $R = 0.20 \pm 0.05$. We observe no background derived from ordinary neutrino or antineutrino interactions that is capable of explaining the muonless signal. (auth)

25271 NEW EXPERIMENTAL LIMIT ON T INVARIANCE IN POLARIZED-NEUTRON β DECAY. Steinberg, R.I. (Yale University, New Haven, Connecticut 06520 and Institut des Sciences Nucléaires, 38044 Grenoble, France); Liaud, P.; Vignon, B.; Hughes, V.W. Phys. Rev. Lett. 33: No. 1, 41-44 (1 July 1974).

We report an improved experimental upper limit for D, the triple-correlation coefficient in polarized-neutron decay. A nonzero value for this coefficient implies a breakdown of T invariance. We find that $D = -(1.1 \pm 1.7) \times 10^{-3}$, consistent with T invariance. (auth)

25272 $|g_A/g_V|$ IN THE DECAY $\Sigma^- \rightarrow ne\bar{\nu}$. Tanenbaum, W.; Hungerbuehler, V.; Majka, R.; Marx, J.; Nemethy, P.; Sandweiss, J.; Willis, W. (Yale University, New Haven, Connecticut 06520); Atac, M.; Ecklund, S.; Gollon, P.J.; Lach, J.; MacLachlan, J.; Roberts, A.; Stefanski, R.; Theriot, D.; Wang, C.L. .Phys. Rev. Lett. 33: No. 3, 175-178 (15 July 1974).

The decay $\Sigma^- \rightarrow ne\bar{\nu}$ was studied using a hyperon beam at the Brookhaven alternating-gradient synchrotron. The Σ^- and e^- momenta were measured by magnetic spectrometers with magnetostrictive wire spark chambers. A threshold Cherenkov counter and a total-absorption calorimeter identified the electron and neutron, respectively. From a sample of 3507 reconstructed events we have found $|g_A/g_V| = 0.435 \pm 0.035$. (auth)

25273 NEUTRAL-CURRENT LIMIT AND FUTURE PROSPECT AT A FISSION REACTOR. Gurr, H.S.; Reines, F.; Sobel, H.W. (Department of Physics, University of California at Irvine, Irvine, California 92664). Phys. Rev. Lett. 33: No. 3, 179-181 (15 July 1974).

Data are presented which yield a new upper limit for the weak neutral-current reaction $\bar{\nu}_e + d \rightarrow n + p + \bar{\nu}_e$ in the MeV range of 6 times theoretical expectation at a 3-standard-deviation level. These data also demonstrate the feasibility of a test which is an order of magnitude more sensitive. (auth)

25274 SLOW DEPOLARIZATION OF POSITIVE MUONS IN AQUEOUS SOLUTIONS OF PARAMAGNETIC IONS. Minaichev, E. V.; Myasishcheva, G. G.; Obukhov, Yu. V.; Roganov, V. S.; Savel'ev, G. I.; Firsov, V. G. JETP Lett. (USSR) (Engl. Trans.); 19: No. 3, 92-94(5 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 2, 149-152(5 Feb 1973).

The spin relaxation time of a μ^+ meson in solutions with different concentrations of a number of paramagnetic ions [A_c] was measured. The results reveal a deep analogy with the data on the proton spin-spin relaxation times (T_2) obtained by the NMR method (with allowance for the difference between the magnetic moments of the proton and the π^+ meson). The deviation from a linear dependence (when plotted in coordinates $\log T_2$ and $\log[A_c]$) at high ion concentrations in the solution are interpreted as a change in the degree of the dissociation of the salt, a change that depends on the nature of the anion. (auth)

25275 EXPERIMENTAL BOUND ON THE PROBABILITY OF THE DECAY $K_L \rightarrow \eta_2(480) + \gamma$. Barmin, V. V.; Davidenko, G. V.; Demidov, V. S.; Dolgolenko, A. G.; Shebanov, V. A.; Shishov, N. N. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 218-219(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 398-400(20 Mar 1974).

The results of a search for the decay $K_L \rightarrow \eta_2(480) + \gamma$ among the photographs of a 180-liter xenon bubble chamber are reported. It is found that at a 90% confidence level the probability of the decay is $\Gamma[K_L \rightarrow \eta_2(480) + \gamma]/\Gamma_L < 1 \times 10^{-4}$. This contradicts the probability obtained for this decay from the hypothesis of A. L. Lyubimov. (auth)

25276 LOWER LIMIT FOR HEAVY MUON MASS OBTAINED FROM THE DATA OF THE CERN NEUTRINO EXPERIMENT. Asratyan, A. E.; Gershtein, S. S.; Kaftanov, V. S.; Kubantsev, M.A.; Lapin, V. V.; Polomeshkin, V. N.; Khovanskii, D. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). Phys. Lett., B; 49: No. 5, 488-490(13 May 1974).

A lower limit for the heavy muon (heavy lepton μ'^- which can have the same lepton number as μ^- and ν_μ) mass $M_{\mu'} > 1.8$ GeV at 90% confidence level is obtained with the help of the bubble chamber "Gargamelle" data in the CERN neutrino experiment. This limit should not be confused with the known limit for an M^+ (heavy lepton M^+ which can have the same lepton number as μ^- and ν_μ). (auth)

25277 RATIO OF POSITIVE TO NEGATIVE PION-ELECTRON COINCIDENCES IN DEEP INELASTIC ELECTROPRODUCTION. Hartmann, J. L. Ithaca, NY; Cornell Univ. (1974). 101p. University Microfilms Order No. 74-18,101.

Thesis (Ph. D.).

Electron-charged pion coincidences were measured at the Cornell Electron Synchrotron for electrons scattered in the range $Q^2 = 0.4$ to 1.7 GeV^2 and $W = 1.8$ to 3.6 GeV. From this data, ratios of inclusive positive to negative pion electroproduction were measured. Electrons scattered 8.5 degrees were detected and momentum analyzed in an electron spectrometer consisting of a bending magnet, wire spark chambers, and a lead-glass sandwich absorption counter. Pions were detected by a counter array after passing through the aperture of a 72D18 magnet. Tracks were measured in wire spark chambers. The pions were identified by momentum and time of flight. Corrections were made to the data for inefficiencies and dead-time effects, and the data distributions were corrected for backgrounds. The primary conclusions from the data are the following: The inclusive π^+ yield seems to increase relative to the π^- yield as Q^2 increases in the central region of longitudinal momenta. The average transverse momentum of π^- is greater than that of π^+ in the x range -0.5 to $+0.1$. If one assumes an exponential form in $P_\perp^2$ for both charges of pions, then the coefficients of the exponent differ by 1.2 ± 0.6 GeV^{-2} over the kinematic region studied. (Diss. Abstr. Int., B)

Strong (Baryon-induced)

Refer also to abstract 24110.

25278 (COO-1112-216) SPIN EFFECTS IN PROTON-PROTON SCATTERING. Krisch, A. D. (Michigan Univ., Ann Arbor (USA). Randall Lab. of Physics). 1974. 6p. (CONF-740332-4; UM-HE-74-5). Dep. NTIS $4.00.

From 9th rencontre de moriond conference; Meribelles-Allues, France (3 Mar 1974).

The p + p elastic scattering at 6 GeV/c in the range of momentum squared from 0.5 to 1.6 (GeV/c)^2 was studied in all possible initial spin states. The cross sections, asymmetry parameters (or polarization), and the difference between the parallel and antiparallel cross sections were considered. (JFP)

25279 (COO-2009-73) RECENT MEASUREMENTS OF POLARIZATION IN PP ELASTIC SCATTERING. Rust, D. R. (Indiana Univ., Bloomington (USA)). 1973. Contract AT(11-1)-2009. 21p. (CONF-740458-1). Dep. NTIS $4.25.

From symposium on high energy physics with polarized beams; Argonne, Illinois, USA (Apr 1974).

Two experiments to measure pp polarization are described. The first is at large momentum transfer at 5.15, 7.0 and 12.33 GeV/c. A periodic structure of maxima and minima is found which is well fit by an optical model. The second experiment concentrated on the region $.02 < -t < .2$ (GeV/c)^2 at 6 GeV/c. The results of the experiments are presented. No unusual features are found. (auth)

25280 (COO-3072-29) ATOMIC NUMBER DEPENDENCE OF HADRON PRODUCTION AT LARGE TRANSVERSE MOMENTUM IN 300 GeV PROTON-NUCLEUS COLLISIONS. Cronin, J. W.; Frisch, H. J.; Shochet, M. J.; Boymond, J. P.; Mermod, R.; Piroue, P. A.; Sumner, R. L. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.; Princeton Univ., N. J. (USA). Joseph Henry Labs.). 15 Jul 1974. Contract AT(11-1)-3072. 10p. (CONF-740713-18). Dep. NTIS $4.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In an experiment at the Fermi National Accelerator Laboratory the production of large transverse momentum hadrons from targets of W, Ti, and Be bombarded by 300 GeV protons was compared. The hadron yields were measured at 90° in the proton-nucleon c.m. system with a magnetic spectrometer equipped with two Cerenkov counters and a hadron calorimeter. The production cross sections have a dependence on the atomic number A that grows with $P_\perp$, eventually leveling off proportional to $A^{1.1}$. (auth)

25281 (COO-3072-30) PRODUCTION OF HADRONS WITH LARGE TRANSVERSE MOMENTUM AT 200, 300, AND 400 GeV. Cronin, J. W.; Frisch, H. J.; Shochet, M. J.; Boymond, J. P.; Mermod, R.; Piroue, P. A.; Sumner, R. L. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.; Princeton Univ., N. J. (USA). Joseph Henry Labs.). 15 Jul 1974. Contract AT(11-1)-3072. 30p. (CONF-740713-19). Dep. NTIS $4.50.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

As a function of transverse momentum ($p_\perp$), the invariant cross section $Ed\sigma/d^3p$ for the production of $\pi^\pm$, $K^\pm$, p, $\bar{p}$, d, and $\bar{d}$ in p-nucleus collisions was measured at incident proton energies of 200, 300, and 400 GeV. The measurements were made in the region of 90° in the c.m. system of the incident proton and a single nucleon at rest. At large values (>0.40) of the scaling variable $x_\perp = 2p_\perp/\sqrt{s}$, where s is the square of the c.m. energy, the pion data are found to be well represented by an expression of the form $s^{-n}e^{-ax_\perp}$, with $n = 5.5 \pm 0.2$ and $a = 36.0 \pm 0.4$. At $x_\perp < 0.35$, where similar measurements have been made at the CERN ISR, the data are in excellent agreement with the ISR data. Results for other hadrons are presented. (auth)

25282 (LBL-2939) POLARIZATION TRANSFER IN PROTON-DEUTERON ELASTIC SCATTERING. Rad, F. N.; Birchall, J.; Conzett, H. E.; Roy, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1974. Contract W-7405-eng-48. 4p. (CONF-740822-2). Dep. NTIS $4.00.

From conference on few body problems in nuclear and particle physics; Quebec, Canada (27 Aug 1974).

The polarization transfer coefficient $K_y^{y'}(\theta)$ in N-d scattering was measured at $E_d = 45.4$ MeV, $\theta_{Lab} = 38$, 41, and 44°. Results are in good agreement with the recent three-body calculations using a perturbation technique with rank-1 separable potentials. (auth)

25283 (UR-492) HADRON PRODUCTION IN PROTON-PROTON INTERACTIONS AT 102 AND 405 GeV/c. Bromberg, C. M. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). Apr 1974. 117p. (COO-3065-85). Dep. NTIS $9.00.

Thesis.

Utilizing exposures of the ANL/NAL 30-inch hydrogen filled bubble chamber, the characteristics of inclusive particle production at 102 and 405 GeV/c were investigated. A two-component description, which characterizes the events as either diffractive or multiperipheral in nature, is in good agreement with the data. A comparison of the multiplicity distributions at 102 and 405 GeV/c with similar data in this energy range indicate an approximate ln s growth of the mean multiplicity ($\langle n \rangle$) and a $\ln^2 s$ growth of the second Mueller moment (f_2) of the negative-particle multiplicity distribution. Two-component descriptions are shown to provide a reasonable framework which can reproduce the latter behavior. Approximately a 6 mb single diffraction component ($|x| < 0.9$, $p_T^2 < 0.6$ GeV^2/c^2) is observed in the inclusive proton production spectra at 102 and 405 GeV/c. The relatively small value noted for the single diffraction component (~20% of the inelastic cross section) rules out simple fragmentation ideas as viable models for the full inelastic cross section. The low mass diffractive peak in the invariant cross section does not scale in the Feynman variable x; the data are more strongly peaked toward $x = -1$ at 405 GeV/c than at 102 GeV/c. A scaling behavior in x is noted (to ~6%) for the nondiffractive region of proton production which was investigated ($-0.9 < x < -0.5$). The inclusive cross sections for neutral meson production (π^0, K_s^0) are observed to rise with s, whereas Λ^0 production is consistent with no s dependence in the 102 to 405 GeV/c energy range. The invariant cross sections for π^0 and K_s^0 near $x = 0$ do not scale; the cross sections at $x = 0$ are larger at 405 GeV/c than at 102 GeV/c. A positive correlation is observed between the number of charged particles and the average number of neutral pions produced in the collisions at 102 and 405 GeV/c; the correlation is stronger at 405 GeV/c than at 102 GeV/c. Charged pion production was investigated at 102 GeV/c. An approximate scaling region for π^- is observed for laboratory rapidities $y_{LAB} < 0.5$ at incident

momenta as low as 12 GeV/c. The cross sections for pion production in the central region ($y_{c.m.} \sim 0$) do not scale; the rise in the π^- cross section at $y_{c.m.} = 0$ is consistent with an approach to scaling as $s^{-\frac{1}{2}}$ suggested by Mueller-Regge ideas. Two pion correlations are shown to exhibit a strong short-range correlation behavior between pions of opposite charges when they are produced in the central region $|y_{c.m.}| < 1$. A simple pion emission model is compared with the correlation data; the short-range behavior is not reproduced by the model. Strong dynamical clustering effects are therefore indicated which (when compared with other data from NAL and ISR) are similar to those predicted on the basis of multiperipheral models. (auth)

25284 (USIP-73-21) CORRELATIONS OF TRANSVERSE MOMENTA IN 9.2 GeV/c ANTIPROTON-PROTON REACTIONS. Carlsson, R.; Ekspong, G.; Holmgren, S. O.; Nilsson, S.; Stenbacka, R.; Walck, C.; Gregory, P.; Mason, P.; Muirhead, H.; Warren, G. (Stockholm Univ. (Sweden). Fysiska Institutionen). Dec 1973. 11p. (CONF-730943-17). Dep. NTIS (US Sales Only) $4.00.

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The two-particle transverse momentum correlations were studied in the reactions $p\bar{p} \rightarrow p + \bar{p} + X$ at 9.2 GeV/c. It is shown that the azimuthal angle ϕ_{12} between the transverse momenta of the particles is not very sensitive to effective mass correlations in the final state. The abundant ϑ and $\bar{\vartheta}$ production is not reflected in the distributions. The general trend is in agreement with the predictions from a peripheral phase space model. The variables $P_T^2/\Sigma P_T^2$ and ΣP_T^2 do not seem to give better discrimination. The distribution of the variable ΣP_T^2 seems to be the most sensitive to effective mass final state correlations. The distribution for events with ϑ and $\bar{\vartheta}$ compared with the distribution for all events gives a $X^2 = 23$ for 9 degrees of freedom, i.e., a probability of 0.005. (auth)

25285 (USIP-73-23) EXCLUSIVE CONTRIBUTIONS TO INCLUSIVE DISTRIBUTIONS IN 9.2 GeV/c ANTIPROTON-PROTON REACTIONS. Carlsson, R.; Ekspong, G.; Holmgren, S. O.; Nilsson, S.; Stenbacka, R.; Walck, C.; Gregory, P.; Mason, P.; Muirhead, H.; Warren, G. (Stockholm Univ. (Sweden). Fysiska Institutionen). Dec 1973. 28p. (CONF-730943-19). Dep. NTIS (US Sales Only) $4.50.

From second international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

All reactions in 9.2 GeV/c antiproton-proton reactions in an exposure in the CERN 2m HBC were measured and identified in an exclusive way. This gives a unique possibility to investigate how inclusive distributions are built up from different exclusive final states. A preliminary estimate of the cross sections for 33 final states and the cross sections for charged prongs are given. The weighted distribution of the Feynman variable x in CMS has an average of $\langle x \rangle = 0.070 \pm 0.005$ in the direction of the nucleon for positive pions and in the direction of the antinucleon for negative pions. The distribution of the rapidity y for the π^- is compared with the prediction of a peripheral phase space model for a reaction with two mesons. A dependence of the P_T^2 distribution of the proton/antiproton on the final state was established. The weighted distributions of the variable x for the proton/antiproton are very different for different final states. As a consequence of the strong variation of x one expects also a strong variation of the mass of the residual system X in the inclusive reaction. This is shown, and the average number of pions as a function of the mass M_x of the residual system was measured. The mass distribution of the system $X^+ \rightarrow N_\pi$ shows contributions from resonances Δ^+ (1236) and Δ^+ or N^+ (1700). The mass distribution of the p_T^+-system shows that it is possible to define a Δ^{++} by a mass cut $1.15 \leq p_T^+ \leq 1.35$ with a background of less than 20%. The variation of the average multiplicity of the cluster X in $p\bar{p} \rightarrow \bar{p} + X^+$ and $\bar{p}p \rightarrow \Delta^{++} + X^{++}$ + CC is consistent with the statistical bootstrap model. (auth)

25286 OBSERVATION OF LARGE-TRANSVERSE-MOMENTUM MUONS DIRECTLY PRODUCED BY 300-GeV PROTONS. Boymond, J.P.; Mermod, R.; Piroué, P.A.; Sumner, R. L. (Department of Physics, Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540); Cronin, J.W.; Frisch, H.J.; Shochet, M.J. Phys. Rev. Lett. 33: No. 2, 112-115 (8 July 1974).

We have observed muons produced directly in Cu and W targets by 300-GeV incident protons. We find a yield of muons which is approximately a constant fraction (0.8×10^{-4}) of the pion yield for both positive and negative charges and for transverse momenta between 1.5 and 5.4 GeV/c. (auth)

25287 BACKWARD $\bar{p}p$ CHARGE EXCHANGE FROM 1 TO 3 GeV/c. Storer, J.; Cutts, D.; Good, M.L.; Grannis, P.D.; Green, D.; Lee, Y.Y.; Pittman, R. (State University of New York, Stony Brook, New York 11790); Benvenuti, A.; Fischer, G.C.; Reeder, D.D. Phys. Rev. Lett. 32: No. 17, 950-953 (29 Apr 1974).

We have measured the differential cross section for $\bar{p}p \rightarrow \bar{n}n$ near 180° in the center of mass for incident $\bar{p}$ momenta between 1 and 3 GeV/c. A backward peak is observed at all energies, whose slope increases with increasing momentum. The s dependence shows some departure from smooth behavior. The magnitude of backward charge-exchange scattering is comparable to backward elastic scattering and thus rules out a diffractive interpretation of the s-dependent structure. (auth)

25288 APPROXIMATE SCALING OF MULTIPLICITY DISTRIBUTIONS AS A FUNCTION OF MISSING MASS. Barshay, S.; Engelmann, R.; Kafka, T.; Pratap, M.; Yamaguchi, Y. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11790); Barish, S.J.; Colley, D.C.; Schultz, P.; Whitmore, J. Phys. Rev. Lett. 32: No. 24, 1390-1392 (17 June 1974).

Data from p+p-p+X at 102, 205, and 405 GeV and from π^-+p-p+X at 205 GeV exhibit an approximate scaling property in the charged-prong multiplicity distributions as a function of the missing mass for the range $5 \leq M_X \leq 13$ GeV. (auth)

25289 OBSERVATION OF A DIFFRACTION MINIMUM IN THE PROTON-PROTON ELASTIC SCATTERING AT THE ISR. Boehm, A.; Bozzo, M.; Ellis, R.; Foeth, H.; Ferrero, M. I.; Maderni, G.; Naroska, B.; Rubbia, C.; Sette, G.; Staude, A.; Strolin, P.; De Zorzi, G. (Technische Hochschule Aachen (F.R. Germany). 3. Physikalisches Inst.). Phys. Lett., B; 49: No. 5, 491-496(13 May 1974).

The pp elastic scattering has been investigated at the CERN Intersecting Storage Rings (ISR). Results are reported for centre-of-mass scattering angles between 30 and 100 mrad and for centre-of-mass energies of 23.5, 30.7, 44.9 and 53 GeV. The elastic differential cross-section shows a diffraction-like shape with a sharp minimum at about $t = -1.4$ GeV^2. (auth)

25290 TWO-PARTICLE RAPIDITY CORRELATIONS IN 205 GeV/c PP INTERACTIONS. Singer, R.; Cho, Y.; Fields, T.; Hyman, L. G.; Schreiner, P. A. (Argonne National Lab., Ill. (USA)); Voyvodic, L.; Walker, R.; Whitmore, J. (National Accelerator Lab., Batavia, Ill. (USA)); Engelmann, R.; Kafka, T.; Moore, C.; Pratap, M. (State Univ. of New York, Stony Brook (USA)). Phys. Lett., B; 49: No. 5, 481-487(13 May 1974).

Using data obtained from an exposure of the 30-inch bubble chamber at NAL, inclusive two-particle rapidity correlations are analyzed for charged-charged, −−, ++, and +− particles. For the inclusive sample, positive correlations are observed in the central region. In the semi-inclusive case, the four- and six-prong events exhibit strong positive correlations near 90° CM. Selection of four-prong events with a large rapidity gap shows that the strong correlation seems to be associated with diffractive-type events. (auth)

25291 RECENT RESULTS FROM HADRONIC EXPERIMENTS AT NATIONAL ACCELERATOR LABORATORY. Ferbel, T. (Univ. of Rochester, NY). Ann. N. Y. Acad. Sci.; 229: 124-154 (20 May 1974).

The latest results obtained at NAL are reviewed and an attempt is made to correct them with what has been learned about similar processes studied at both lower and higher energies. Five distinct subjects are treated. Measurements of particle multiplicities are discussed in the first section. The second part is devoted to an examination of the properties of a large inelastic, diffractively produced component in proton-proton collisions at high energies. This is followed by a brief treatment of measurements of elastic and total cross sections. The fourth part is concerned with production cross sections at large transverse momenta and finally, the last section deals with questions of scaling and factorization in inclusive reactions. (LBS)

25292 INTERSECTING STORAGE RINGS: REVIEW OF RECENT RESULTS FROM THE EUROPEAN CENTRE FOR NUCLEAR RESEARCH. Sens, J. C. (CERN, Geneva). Ann. N. Y. Acad. Sci.; 229: 155-192 (20 May 1974).

Results of experimental studies of proton-proton interaction at ISR beam momenta of 2×11.8, 2×15.3, 2×22.4, and 2×26.7 GeV/c are presented in four categories: elastic scattering and the total cross section, large transverse momenta, diffraction dissociation, and correlations. (LBS)

25293 DYNAMICS OF ANTIPROTON INTERACTIONS. Muirhead, H. (Oliver Lodge Lab., Liverpool). Czech. J. Phys.; 24: No. 7, 725-742(1974).

The experimental data for the antiproton annihilation process are reviewed. A phenomenological approach is employed in analyzing this information, and tentative conclusions are drawn concerning the underlying dynamics. (auth)

25294 DEPENDENCE OF THE SECONDARY-PARTICLE MULTIPLICITY ON THE TARGET-NUCLEUS ATOMIC WEIGHT

AND CROSS SECTION OF INELASTIC INTERACTIONS. Atanelishvili, M. I.; Berdzenishvili, O. L.; Verbetskii, Yu. G.; Gromov, Yu. A.; Kotlyarevskii, D. M.; Matsaberidze, F.; Struchalina, A. V.; Chikovani, L. D.; Tsomaya, P. V.; Shtemanetyan, G. Z. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 221-222(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 405-409(20 Mar 1974).

The dependence of the multiplicity of the secondary particles on the energy of the primary particle and on the atomic weight of the target nucleus; it is shown how the secondary-particle multiplicity is connected with the inelastic-interaction cross sections in different nuclei. (auth)

25295 NEUTRON-PROTON FORWARD ELASTIC SCATTERING FROM 58 TO 391 MeV. Bersbach, A. J. Princeton, NJ; Princeton Univ. (1974). 86p. University Microfilms Order No. 17-17,438.

Thesis (Ph. D.).

Elastic neutron-proton differential cross sections were measured between 58 and 391 MeV incident neutron energy at c.m. angles from 11 to 54°. Neutrons were scattered from the liquid-H_2 target and detected in liquid scintillators. The incident energy of each detected neutron was determined from its time of flight. The data were normalized by placing the detector in the beam. The results are generally consistent with previous data and with the predictions of phase shift analysis but are of improved accuracy. (Diss. Abstr. Int., B)

Strong (Meson-induced)

25296 (BNL-19000) HIGHER STATISTICS INVESTIGATION OF $K_1^0K^-$ DECAY OF THE A_2^- PRODUCED BY 23 GeV/c π^- ON HYDROGEN. Lindenbaum, S. J.; Foley, K. J.; Love, W. A.; Ozaki, S.; Platner, E. D.; Saulys, A. C.; Willen, E. H.; Kramer, M. A.; Margulies, M. (Brookhaven National Lab., Upton, N. Y. (USA); City Coll., New York (USA)). [nd]. 25p. (CONF-740713-22). Dep. NTIS $4.25.

From seventeenth international conference on high-energy physics; London, UK (1 Jul 1974).

Using the BNL MK1 spectrometer, 3600 new events of the type $\pi^-p \to K_1^0K^- + p$ in the effective mass range $M(K_1^0K^-) = 1.1-1.5$ GeV were obtained and analyzed. This is a preliminary report on these results. The effective mass resolution is $\sigma = 4.5 \pm 0.8$ MeV. The statistics represent a fivefold increase compared to a previous experiment. The $K_1^0K^-$ effective mass spectrum shows a single peak in the A_2 mass region which is well fitted by a D-wave Breit-Wigner shape. The data in the A_2 peak region agree with previous results and rule out conclusively (>10 standard deviations) the split A_2 shape reported earlier by other investigators. The background level is ≈10 to 15%. The A_2 decay angular distributions are well described by a single resonance with $J^P = 2^+$. The data were subdivided into the following three t' regions, where $t' = t - t_{min}$ in units of $(GeV/c)^2$: a) $0 < -t' < 0.2$, b) $0.2 < -t' < 0.29$, and c) $0.29 < -t' < 1.0$, and each region is well fit by a single D-wave Breit-Wigner. No split is observed in any -t' region. The "double pole" formula used for the CERN missing mass data, even with the more limited statistics for each subdivision, gives a χ^2 equivalent to ≳3 standard deviations for the dipole fits. The background level was a free parameter but reached obviously unreasonably high levels (as much as 35%). (auth)

25297 (BNL-19029) STUDY OF K^+d INTERACTIONS IN THE REGION OF 600 TO 1000 MeV/c. Sakitt, M.; Skelly, J.; Thompson, J. A. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 19p. (CONF-740713-23). Dep. NTIS $4.00.

From seventeenth international conference on high-energy physics; London, UK (1 Jul 1974).

Detailed study was made of both $K^+ + p$ and $K^+ + d$ scattering at 600 to 1000 MeV in a bubble chamber. Differential cross sections of the elastic and inelastic channels were measured, and a phase shift analysis was performed with these data. Preliminary results are given on the $K^+ + d$ elastic differential cross sections and $K^+ + n$ elastic and charge-exchange cross sections as a function of incident K momentum. (JFP)

25298 (JINR-E1-7934) EXPERIMENTAL SETUP FOR THE STUDY OF ELASTIC π^-p SCATTERING AT SMALL ANGLES FOR ENERGIES OF 40 AND 50 GeV. Adylov, G. T.; Aliev, F. K.; Filippov, P. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 23p. Dep. NTIS (US Sales Only) $4.25.

The experimental set-up with the selective triggering system was used for the study of elastic π^-p scattering at small angles for energies of 40 and 50 GeV. The information from the proportional chambers was processed by an analog device giving permission for triggering the magnetic spectrometer. (auth)

25299 (LBL-3010) AMPLITUDE ANALYSIS OF $(3\pi)^+$ PRODUCTION AT 7 GeV/c. Tabak, M.; Ronat, E. E.; Rosenfeld, A. H.; Lasinski, T. A.; Cashmore, R. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 14p. (CONF-740408-3; SLAC-PUB-1462). Dep. NTIS $4.00.

From 4th international conference on experimental meson spectroscopy; Boston, Massachusetts, USA (26 Apr 1974).

An amplitude analysis of the reaction $\pi^+p \to p(\pi^-\pi^+\pi^+)$ at 7 GeV/c is in progress. Although the method of analysis and assumptions are quite different from those of the Illinois group, the preliminary results are nevertheless consistent with theirs. Coherent amplitudes, not the density matrix, are fitted and different assumptions are made about decay amplitudes of J^P states into various isobars. This approach, furthermore, allows a much larger set of partial waves to be examined than that quoted by the Illinois group, at the expense of imposing explicit rank conditions on the density matrix. (auth)

25300 (LBL-3045) INCLUSIVE MESON RESONANCE PRODUCTION. Winkelmann, F. C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1974. Contract W-7405-eng-48. 23p. (CONF-740408-4). Dep. NTIS $4.25.

From 4th international conference on experimental meson spectroscopy; Boston, Massachusetts, USA (26 Apr 1974).

The status of inclusive meson resonance production is reviewed. New data is presented on inclusive ρ^0 production in 205 GeV/c π^-p interactions. (auth)

25301 (ORO-2504-216) LOW MOMENTUM K^+-PROTON SCATTERING. Technical Report No. 74-112. Burnstein, R. A.; LeFebvre, J. J.; Petersen, D. V.; Rubin, H. A.; Day, T. B.; Fram, J. R.; Glasser, R. G.; McClellan, G.; Sechi-Zorn, B.; Snow, G. A. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1974. 29p. Dep. NTIS $4.50.

The differential cross section for K^+p elastic scattering was measured at several momenta in the interval 200 to 600 MeV/c within a hydrogen bubble chamber. The data were fit with a partial wave analysis. Solutions which are dominated over the entire momentum range by s-wave scattering, with constructive interference between the nuclear and Coulomb scattering were obtained. The effective-range approximation with only s-waves yields a K^+p scattering length $a = -0.314 \pm 0.007$ f and an effective range $r_0 = 0.36 \pm 0.07$ f. The measured total inelastic cross section at 588 MeV/c is 11^{+2}_{-3} μb. (auth)

25302 Q^+ OR Q^- PRODUCTION IN K^+ OR K^-p INTERACTIONS AT 14 GeV/c. Barloutaud, R. (CEN de Saclay, Gif-sur-Yvette, France). pp 383-399 of Proceedings of the Eighth Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Orsay, France; Univ. Paris ([nd]).

From 8th Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

New results on the production differential cross sections of the $Q^- \to K^0$ or $K^-\pi^0$ or $\pi^+\pi^-$ at 14.3 GeV/c are presented. The comparison to the $Q^+ \to K^0$ or $K^+\pi^0$ or $\pi^-\pi^+$ production differential cross sections at the same incident momentum shows a definite cross-over. The relative amounts of $C = -1$ and $I = 1$ t-channel exchange amplitudes are found to be about equal in Q^- production and in K^-p elastic scattering at about the same incident momentum. (FR)

25303 COHERENT PION DISSOCIATION INTO THREE PIONS ON NUCLEAR TARGETS. Kruse, U.E.; Roberts, T.J. (University of Illinois, Champaign-Urbana, Illinois 61801); Edelstein, R.M.; Makuchowski, E.J.; Meltzer, C.M.; Miller, E.L.; Russ, J.S.; Gobbi, B.; Rosen, J.L.; Scott, H.A.; Shapiro, S.L.; Strawczynski, L. Phys. Rev. Lett. 32: No. 23, 1328-1330 (10 June 1974).

A partial-wave decomposition has been made of the final-state 3π system produced in the reaction $\pi^- + A \to (\pi^-\pi^-\pi^+) + A$ at 23 GeV/c and for the elements C, Al, Cu, and Ag. For low 3π masses, the 1^+ state is dominant and its t' distribution shows the expected combination of coherent and incoherent components. The t' distribution of the 2^+ A_2 state also requires both coherent and incoherent components. (auth)

25304 φ MESON PRODUCTION IN π^-p AND K^-p INTERACTIONS FROM 3 TO 6 GeV/c. Ayres, D.S.; Diebold, R.; Greene, A.F.; Kramer, S.L.; Levine, J.S.; Pawlicki, A.J.; Wicklund, A.B. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 32: No. 25, 1463-1467 (24 June 1974).

Cross sections and density-matrix elements for $\pi^-p \to \varphi n$ have been measured for $-t \lesssim 1.5$ GeV^2 at 3, 4, 5, and 6 GeV/c, using the Argonne effective-mass spectrometer to observe the decay $\varphi(1019) \to K^+K^-$. This is the first observation of the reaction in this energy range. The remarkable flat differential cross section at 4 GeV/c and the strong energy dependence suggest a production mechanism not normally seen at these energies. Data on $K^-p \to \varphi\Lambda$ and $K^-p \to \varphi\Sigma^0$ from the same experiment are also presented. (auth)

25305 ENERGY DEPENDENCE OF THE DOUBLE-CHARGE-EXCHANGE REACTIONS $\pi^- p \to K^+ \Sigma^-$, $K^- p \to \pi^+ \Sigma^-$, AND $K^- p \to K^+ \Xi^-$. Akerlof, C.W.; Caldwell, P.K.; Koschik, J.; Kotthaus, R.; Meyer, D.I.; Spingett, B. (Physics Department, The University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. Lett. 33: No. 2, 119-122 (8 July 1974).

In an experiment at the Argonne National Laboratory zero-gradient synchrotron we have determined the forward differential cross sections for the double-charge-exchange reactions $\pi^- p \to K^+ \Sigma^-$, $K^- p \to \pi^+ \Sigma^-$, and $K^- p \to K^+ \Xi^-$ for incident beam momenta up to 5 GeV/c. The production angle and momentum of the forward-going positive particle (π^+ or K^+) were measured with a high-resolution focusing wire-spark-chamber spectrometer and the two-body final states were selected by the missing-mass technique. (auth)

25306 DIRECT MEASUREMENT OF CHARGED PION PRODUCTION BY HIGH ENERGY HEAVY IONS. Koepke, K. P. O. New York; New York Univ. (1973). 126p. University Microfilms Order No. 74-13,345.

Thesis (Ph. D.).

Differential cross sections for the production of charged pions by collisions between 7420 MeV (530 MeV/amu) nitrogen nuclei and ten targets were measured for laboratory pion production angles of 3 and 15 degrees and pion kinetic energies ranging from 160 to 670 MeV at the Princeton Particle Accelerator. The pion production targets used in the experiment were beryllium, carbon, aluminum, sulfur, iron, copper, silver and lead. Polyethylene (CH_2) and Teflon (C_2F_4) targets were used to permit determinations of cross sections for hydrogen and fluorine. (JFP)

25307 CASCADE RESONANCE PRODUCTION IN HYDROGEN AND DEUTERIUM. Fernow, R. C. New York; Syracuse Univ. (1973). 188p. University Microfilms Order No. 74-17,572.

Thesis (Ph. D.).

The production of cascade (Ξ) resonances in a 20 event/microbarn exposure of deuterium to 2.88 GeV/c K^- mesons. The experiment was done in collaboration with Brandeis, Maryland, and Tufts Universities (BMST) using the 31" bubble chamber exposed at the A.G.S. at Brookhaven National Laboratory. The unitary symmetry predictions concerning cascade resonance and the experimental work which has been previously on these states was reviewed. The $K^- p$ and $K^- n$ channel cross sections were determined. The $K^- p$ channels were examined for evidence of Ξ resonance production and best values for the masses, widths, and fractions were determined. The data from this experiment was added to that of an earlier 2.88 GeV/c $K^- p$ experiment by the BMST collaboration. In general the amount of Ξ resonance production was found to be smaller than was determined in the earlier experiment. The questionable $\Xi(1630)$ state is only produced with marginal statistical significance in the combined data. (Diss. Abstr. Int., B)

Particle Interactions and Properties (Theoretical)

Refer also to abstracts 24960 and 25253.

General

25308 (GIFT-7/71) ANALYTICAL THEORY OF THE S MATRIX. Proceedings of the II GIFT Seminar in Theoretical Physics, Universidad Autonoma de Madrid, 5-10 April 1971. (Grupo Interuniversitario de Fisica Teorica de Altas Energias (GIFT), Zaragoza (Spain)). 1971. 275p. (CONF-710473-).

From second GIFT seminary on theoretical physics; Madrid, Spain (5 Apr 1971).

The conference included six papers. Separate abstracts were prepared for all papers. (JFP)

For abstracts of individual papers see: 25350, 25385, and 25418-25421.

25309 (ORO-2504-221) TVGP AND SQUAW CHANGES AT Md., 1969 TO DECEMBER 1973. Technical Report No. 75-005. Kehoe, B.; Hill, D. G. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jun 1974. 179p. Dep. NTIS $12.00.

The availability of a set of revisions to the Maryland TP/SQ programs, version 73A, reflecting all changes made locally since June, 1969, is announced. The changes documented include those necessitated by the incorporation of the Argonne version of MATCH in the program, the desire to allow more than 3 fiducials, conversion of the program to the UNIVAC 1108 from the IBM 7094. (JFP)

25310 (RL-74-038, pp II.1-II.34) LECTURES GIVEN AT SUMMER SCHOOL FOR EXPERIMENTAL HIGH ENERGY PHYSICS. Cottingham, W. N. Mar 1974.

The lecture deals with the basic theory of particle physics, which includes discussions on the quark model, symmetries, particle exchange, meson-baryon scattering, amplitude analysis, decay of unstable particles, the decay $K^*(890) \to K\pi$, and spin and parity determination. (LBS)

25311 GENERALIZED CONSTRAINTS AND MASS SPECTRA IN CLASSICAL SPIN THEORY. Rafanelli, K. (Queens College of the City University of New York, Flushing, New York 11367). Phys. Rev. D 9: No. 10, 2746-2748 (15 May 1974).

The classical theory of a relativistic spinning point particle is reexamined and reformulated from a new perspective. We introduce a class of generalized constraints on the spin angular momentum tensor, whose imposition has not been previously considered. A constraint-dependent functional relationship between the observable rest mass and spin is deduced, and the implied trajectories analyzed. (auth)

25312 APPROXIMATE SOLUTIONS OF PREDICTIVE RELATIVISTIC MECHANICS FOR SHORT-RANGE SCALAR INTERACTIONS. Bel, L.; Martin, J. (Universidad Autónoma de Madrid, Departamento de Física, Canto Blanco, Madrid, Spain). Phys. Rev. D 9: No. 10, 2760-2766 (15 May 1974).

We solve the equations of predictive relativistic mechanics for the short-range scalar interaction of two structureless point particles, up to the second order in the coupling constant. The main ideas of this paper are very similar to those of a preceding one dealing with the electromagnetic interaction. But some recent results about the degeneracy of predictive Poincaré-invariant systems have also been used to deal with the nontrivial complications which arise from the consideration of short-range interactions. (auth)

25313 ON GOLDSTONE FERMIONS. Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Phys. Lett., B; 49: No. 5, 465-467(13 May 1974).

Spontaneous violation of super-gauge symmetries is considered. One consequence must be the emergence of a particle with spin $\frac{1}{2}$ and mass zero. (auth)

Electromagnetic

25314 (DESY-73/44) ELECTROMAGNETIC INTERACTIONS. Ting, S. C. C. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1973. 21p. INIS.

28 figs.; 34 refs.

These lectures consist of three parts: A. The interaction between photons and electrons or muons. The study of quantum electrodynamics. B. The interaction between real photons and vector mesons. The questions on vector dominance. C. The interaction between virtual photons and hadrons. The question on scaling and structure functions. (auth)

25315 (DESY/74/23) OFF-DIAGONAL GENERALIZED VECTOR DOMINANCE AND INELASTIC e-p SCATTERING. Fraas, H.; Read, B. J.; Schildknecht, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). May 1974. 18p. Dep. NTIS (U. S. Sales Only) $4.00.

By taking into account also off-diagonal contributions to the virtual forward Compton amplitude, scaling in ep scattering is obtained from scaling of the total cross section for e^+e^- annihilation into hadrons. The parameter which sets the scale for the q^2 dependence in ep scattering is calculated to be $\bar{m}^2 \cong 0.61\ m_\rho^2 \cong 0.36\ \text{GeV}^2$. (auth)

25316 (DESY-74/25) STICHEL RELATIONS IN THE MUELLER-REGGE THEORY OF INCLUSIVE PHOTO- AND ELECTROPRODUCTION. Craigie, N. S.; Kramer, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jun 1974. 32p. Dep. NTIS (U. S. Sales Only) $4.75.

The Mueller-Regge formalism for inclusive photo- and electroproduction of pions in the photon fragmentation sector. It is discussed under what assumptions about the analyticity of the six-point function one can derive a Sommerfeld-Watson representation, which involves integrals over the crossed-channel helicities. In particular the properties of the so-called helicity-pole limit (H.P.L.), which is relevant in realizing the Mueller-Regge expansion in the fragmentation region. In the case of the four-point function there exist relations among the s-channel helicity amplitudes at high energies, if only Regge singularities of definite normality are exchanged in the t-channel (Stichel relations). One of the main points made is that in the case of inclusive distributions, these properties carry over the H.P.L. if one takes into account only the leading helicity pole. An important consequence of these relations is that the inclusive photoproduction distributions vanish as $k_T^2 \to 0$ (k_T being the transverse momentum of the pions). (auth)

25317 (DESY-74/27) FIELD THEORETIC MODEL FOR THE PION FORM FACTOR I: FORMALISM. Gutbrod, F.; Weiss, U. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jun 1974. 45p. Dep. NTIS (US Sales Only) $5.25.

The formalism of a field theoretic many channel model for the electromagnetic form factors of the $\pi\pi$, the $K\bar{K}$, the $\pi\omega$ and the $\rho\epsilon$ system is presented. The main attractive force, which generates the ρ-meson, is derived from the nucleon box diagram with phenomenological strong vertex corrections. Propagator self energy corrections are derived from the Ward identity. Long range forces are introduced through the pion exchange coupling between the $\pi\pi$- and $\rho\epsilon$-channel. The photon is coupled minimally to pions, kaons and nucleons, with subtractions performed at large spacelike momenta. The model is solved in the framework of the Bethe-Salpeter equation. (auth)

25318 (EFI-3-72) SPECTRAL DISTRIBUTION OF UNDULATOR RADIATION IN STRONG FIELDS. Korkhmazyan, N. A.; Ehlbakyan, S. S.; Zverev, A. M. (Erevanskij Fizicheskij Inst. (USSR)). 1972. 10p. (In Russian). INIS.

Undulator radiation of charged particles in strong fields is considered. A formula is given for the spectral distribution of radiation from a unit of a flight path. Curves giving the spectral distribution of undulator and synchrotron radiation with definite parameters are shown. (tr-auth)

25319 (JINR-E2-8018) COMPENSATION EFFECT IN PION PHOTOPRODUCTION AND RELATED PROCESSES AND POSSIBILITY OF INVESTIGATING HADRON ELECTROMAGNETIC FORM FACTORS. Surovtsev, Yu. S.; Tkebuchava, F. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

It is shown for process $\gamma N \to \pi N$ that in the physical region of variables of the production amplitude there exist continuous curves along which the differential cross section is completely determined by the Born terms. The possibility of using such curves to reveal the optimal experimental conditions for extracting the model-independent values of the hadron electromagnetic form factors from processes $eN \to e\pi N$ and $\pi N \to e^+e^-N$ is discussed. (auth)

25320 (JINR-P1-7996) SEARCH FOR THE DIRAC MONOPOLE OVER THE VAVILOV-CHERENKOV RADIATION USING THE 70 GeV IHEP PROTON SYNCHROTRON. Zrelov, V. P.; Kollarova, L.; Kollar, D.; Lupil'tsev, V. P.; Pavlovich, P.; Ruzhichka, Ya.; Sidorova, V. I.; Shabashov, M. F.; Yanik, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 26p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.50.

At the proton energy of 70 GeV on the internal target of the IHEP proton synchrotron the search was made for magnetic charges over the Vavilov-Čerenkov radiation and characteristic polarization. Eight Čerenkov counters of a special construction served as detectors. Possible events were recorded with two fast five-ray oscillographs triggered by 6-fold coincidences. The efficiency of the magnetic charge recording was about 10%. The proton beam of $6.4.10^{16}$ intensity traversed the target-radiator; and not a single case of the production of the Dirac monopole with the magnetic charge from minimal one of about $\frac{1}{2}g_D$ (g_D = 68.5 e) up to $2g_D$ was recorded. This means that in the conditions of the experiment the upper boundary of the cross section of the Dirac monopole production by 70 GeV protons per nucleon of Si and O nuclei for magnetic charges of masses from 3 up to $5.5m_p$ was found to be σ (95%) $\simeq 10^{-40}$ cm^2. (auth)

25321 (JINR-P2-7965) ANNIHILATION OF e^+e^- PAIRS TO HADRONS AND PARTON SPECTRA. Matveev, V. A.; Tolkachev, E. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. (In Russian). (CONF-740233-1). Dep. NTIS (U. S. Sales Only) $4.00.

From session of the Division of Nuclear Physics of the Academy of Science; Dubna, USSR (11 Feb 1974).

The experimentally observed behavior of the total cross section of the electron-positron pair annihilation to hadrons is explained proceeding from certain assumptions on the parton mass spectrum. (auth)

25322 (RL-74-038, pp III.1-III.46) ELECTROMAGNETIC INTERACTIONS. Marshall, R. Mar 1974.

The lectures deal with the electromagnetic properties of the hadronic current and also the hadronic properties of the electromagnetic currents. Some of the topics dealt with are: photoproduction of pions, vector dominance model and applications, electroproduction, elastic scattering from a Dirac proton, elastic scattering from a proton with structure, inelastic ep scattering, and inelastic scattering data. (LBS)

25323 (RL-74-056) η_s ABSOLUTE VALUE AND THE REACTION $e^+e^- \to K^0\bar{K}^0$ AT THE PHI-RESONANCE. Dass, G. V. (Science Research Council, Chilton (UK). Rutherford Lab.; Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Apr 1974. 12p. Dep. NTIS (U. S. Sales Only) $4.00.

$|\eta_s|$ can be rather cleanly determined in $e^+e^- \to K^0\bar{K}^0$ at the ϕ-resonance position from the time-distribution of decays of one of the produced kaons within a suitable angular portion of a hemisphere. The procedure described is better than the existing methods. (auth)

25324 (SAND-74-5193) ELECTRON TRANSPORT IN THE PRESENCE OF UNIFORM MAGNETIC FIELDS. Halbleib, J. A. Sr. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 23p. (CONF-740707-10). Dep. NTIS $4.25.

From annual conference on nuclear and space radiation effects; Fort Collins, Colorado, USA (15 Jul 1974).

The model presented describes the transport of relativistic electrons through extended media in the presence of static external magnetic fields of arbitrary spatial orientation. The material geometry must be one-dimensional; however, since the model employs a full three-dimensional description of electron and photon trajectories, one can easily obtain selected two- or three-dimensional outputs from symmetry-breaking source distributions and field orientations. Model versatility is demonstrated through its application to three diverse areas of pulsed-electron-beam research. (auth)

25325 (UCID-15584) ENERGY AND MOMENTUM TRANSFERRED BY COMPTON SCATTERING. Corman, E. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Feb 1968. 11p. Dep. NTIS $4.00.

Curves of expectation values of photon energy gained or lost and momentum transferred to an electron gas by Compton collisions are computed. The electron temperature is varied from 0 to 120 keV in steps of 10 keV, and the initial photon energy ratio $h\nu/mc^2$ is varied from .04 up to unity in steps of .04. These calculations provide only a supplement to those by Stone and Nelson; the only new data presented are the momenta transferred and the zero temperature values. (auth)

25326 THE CHERENKOV TRANSFORMATION AND ITS APPLICATION TO CHERENKOV RADIATION. Ollendorff, F. (Technion-Israel Inst. of Tech., Haifa. Faculty of Electrical Engineering). Arch. Elektrotech. (Berlin); 56: No. 1, 1-11 (1974). (In German).

6 figs.; 4 refs.

The Cherenkov transformation is derived from the Lorentz transformation by replacing the velocity of light in free space by the phase velocity of electromagnetic waves in matter. Both the Maxwell equations and the constituent relations are invariant under this transformation. The application to an ion with uniform velocity in a homogeneous and isotropic, dielectric material is given. This reduces the electromagnetic field of the moving ion into the static field of the ion at rest. For the reciprocal transformation a Fourier integral is used, the spectral density of which unifies all aspects of Cherenkov radiation. (auth)

25327 IS $\eta \to 3\pi$ A SHORT-DISTANCE PROBLEM? Mannheim, P.D. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 9: No. 12, 3438-3449 (15 June 1974).

Wilson has suggested that electromagnetic ultraviolet radiative corrections can induce a u_3 tadpole into the effective electromagnetic Lagrangian for $\eta \to 3\pi$ which would then eliminate Sutherland's soft-pion theorem. We have investigated this proposal within the framework of the σ model in perturbation theory and find no such effect. All induced tadpole counterterms leave the neutral isovector-axial-vector current conserved. We speculate that the "true" u_3 needed for understanding $\eta \to 3\pi$ may have its origin in the infrared structure of the weak interaction. (auth)

25328 MODIFIED EXPANSION FOR VIRTUAL COMPTON AMPLITUDE. Deo, B.B. (Physics Department, Utkal University, Bhubaneswar-4, Orissa, India). Phys. Rev. D 9: No. 12, 3513-3516 (15 June 1974).

From considerations of analyticity and convergence it is shown that the virtual Compton amplitude can be expanded as $T_{\mu\nu}(q_0,\ldots) \sim \Sigma_n w^n C_{\mu\nu}^{(n)}(\ldots)$ where the variable w is obtained by conformally mapping the cut plane of analyticity in q_0 into the inside of a semi-infinite strip. This expansion reduces to the usual Bjorken expansion in the limit of large q_0. (auth)

25329 SIXTH ORDER ELECTRON AND MUON (g-2)/2 FROM SECOND ORDER VACUUM POLARIZATION INSERTION. Barbieri, R. (Scuola Normale Superiore, Pisa (Italy)); Remiddi, E. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 49: No. 5, 468-470(13 May 1974).

The analytic evaluation of sixth order contributions to electron and muon anomalous magnetic moments coming from second order vacuum polarization insertions into all the fourth order graphs is reported. (auth)

25330 POSSIBLE CONSTANCY OF THE TOTAL CROSS-SECTION OF THE e^+e^- ANNIHILATION INTO HADRONS. Renard, F. M. (Montpellier-2 Univ., 34 (France). Dept. de Physique Mathematique). Phys. Lett., B; 49: No. 5, 477-480(13 May 1974).

It is shown how a series of vector mesons can give a constant total cross-section in agreement with the experimental results up to 5 GeV. We discuss also the ratios $n_\pi o/n_\pi^\pm$, n_K/n_π and the breakdown of scaling in the inclusive spectra. (auth)

25331 QUARK MODEL FOR CURRENTS AND ELECTROMAGNETIC HADRON INTERACTIONS. Dushenko, V. F.; Kobushkin, A. P.; Sinyukov, Yu. M. (Inst. of Theoretical Physics, Kiev). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 219-221 (20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 400-404(20 Mar 1974).

A description is obtained of the elastic eN and elastic $e + p \to e + \Delta^+$ (1236) scattering within the framework of the Markov–Yukawa oscillator quark model. (auth)

25332 ELECTROPRODUCTION OF π-MESONS ON NUCLEI AT 1.10 TO 1.2 GeV ENERGY. Ivanchenko, E. A. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 6, 936-941(Jun 1974). (In Russian).

On the basis of a Fermi gas model for the nucleus, the inelastic electron–nucleus cross section was calculated in the region of electron energy loss corresponding to excitation of the first nucleon resonances: $P_{33}(1236)$, $P_{11}(1470)$, $D_{13}(1520)$, $S_{11}(1535)$. It is shown that the resonance mechanism for electroproduction of π mesons on nucleons of the nucleus is not sufficient for a description of experimental data for the q^2 considered and the Born diagrams should be taken into account. (2 figures) (auth)

25333 STRONG-INTERACTION CORRECTIONS TO THE MUON ANOMALOUS MOMENT AND TO THE PHOTON PROPAGATOR. Petrun'kin, V. A.; Startsev, S. A. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 223-224(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 409-413(20 Mar 1974).

An empirical formula with asymptotic behavior $\sim(1/s)$ is obtained for the description of the total cross section of the $e^- - e^+$ annihilation into hadrons in the energy region beyond the ϕ resonance. The formula is obtained to calculate the corrections to the anomalous magnetic moment of the muon and to the propagator of the photon for the hadron polarization of the vacuum. (auth)

25334 VECTOR PARTONS. Esaibegyan, S. V.; Matinyan, S. G. (Erevan Inst. of Physics). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 227-228(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 418-420(20 Mar 1974).

An orthodox parton model is considered in which the charged components of the hadrons have unity spin. It is shown that there is no scaling for the structure functions of deep electroproduction. An upper bound on the possible contribution of vector partons to the structure functions is obtained from data on deep electroproduction. (auth)

25335 EXCLUSIVE FINAL STATES IN ELECTROPRODUCTION. Sullivan, J. D. (Univ. of Illinois, Urbana). Ann. N. Y. Acad. Sci.; 229: 239-258(20 May 1974).

A review is given of some of the theoretical models that have been used to study properties of the final hadronic states formed in electroproduction. These include light core commutators, parton model, vector dominance model, exchange models, and multiperipheral model. (LBS)

25336 DEEP INELASTIC PROCESSES AND FINAL STATES. Yan, T. M. (Cornell Univ., Ithaca, NY). Ann. N.Y. Acad. Sci.; 229: 207-224(20 May 1974).

A brief summary is first given of the present experimental situation and earlier theoretical work on deep inelastic processes induced by the leptons (electron as well as neutrino scattering and e^+e^- annihilation) where no final hadrons are detected. The connection between parton model and light-cone algebra is then discussed. The prediction and its difficulties in the parton model for the rapidity distribution of the final state hadrons are presented. Finally, two sophisticated field theory approaches to short distances by Johnson–Baker–Willey and Wilson are discussed and contrasted. Neither of the approaches predicts simultaneously scaling for e^+e^- annihilation total cross section and Bjorken's scaling in deep inelastic lepton scattering. (auth)

Weak

Refer also to abstract 25555.

25337 (ANL/HEP-7418) SEARCH FOR SIMPLE NEUTRAL-CURRENT INTERACTIONS INDUCED BY NEUTRINOS. Barish, S. J. (Argonne National Lab., Ill. (USA)). 1974. 49p. (CONF-740463-1). Dep. NTIS $5.50.

From meeting of the American Physical Society; Washington, District of Columbia, USA (22 Apr 1974).

A search was made for single pion production by a weak neutral current in exposures of the Argonne 12-foot bubble chamber filled with liquid hydrogen and deuterium to the neutrino beam at the Zero Gradient Synchrotron. Events consisting of (1) a single π^+ meson originating in the liquid and (2) a proton with an e^+e^- pair pointing to it were observed. Only a small fraction of these events can be ascribed to measured background reactions such as $np \to nn\pi^+$ and $np \to np\pi^0$. The remaining events, which correspond to a signal of about 4.5 standard deviations, are ascribed to the neutral-current reactions $\nu_\mu p \to \nu_\mu n\pi^+$ and $\nu_\mu p \to \nu_\mu p\pi^0$. The measured neutral to charged-current cross section ratio is $(\sigma(\nu p \to \nu p\pi^0) + \sigma(\nu p \to \nu n\pi^+))/\sigma(\nu p \to \mu^- p\pi^+) = 0.68 \pm 0.28$, which is consistent with the prediction of the Salam-Weinberg theory. (auth)

25338 (COO-2009-78) BOOTSTRAP SCHEME FOR PARTICLE INTERACTIONS BASED ON AN EIGENVALUE CONDITION FOR THE FINE STRUCTURE CONSTANT. Chu, S. Y. (Indiana Univ. of Pennsylvania (USA). Dept. of Physics). 1974. Contract AT(11-1)-2009. 27p. Dep. NTIS $4.50.

A bootstrap scheme is proposed for particle interactions based on an eigenvalue condition for the fine structure constant α in nonabelian gauge theories. It is assumed that the new renormalization-group equations derived by Weinberg, if the proposed bootstrap conditions are imposed, allow a nontrivial bootstrap solution besides the trivial free field solution. All the dimensionless quantities in the bootstrap scheme then become calculable in principle. In particular, there is a direct way of calculating α assuming perturbation methods are applicable. The validity of the bootstrap assumptions and the reliability of the perturbation methods can be tested in deep-inelastic lepton-hadron scattering experiments. Also the possible origin of the various interactions, the spontaneous breaking of the gauge symmetries, as well as the unification of the leptons with the hadrons are discussed. (auth)

25339 (IC-73/133) TOPICAL SEMINAR ON WEAK INTERACTIONS. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1973. 15p. Dep. NTIS $4.00.

The topics covered include classical weak interactions; experiments on high-energy neutrino beams—a summary of recent results at CERN; gauge models; unified lepton-hadron symmetry; survey on neutral currents; weak effects in e^+e^- colliding beam reactions; status of $\bar{\nu}_e + e^- \to \bar{\nu}_e + e^-$ experiment; hot stars and $(e\nu)(e\nu)$ astrophysics; neutrino rest mass from cosmology, review of the solar neutrino puzzle, and neutrinos from collapsing stars. (auth)

25340 (RL-74-038, pp VI.1-VI.20) EXPERIMENTAL SITUATION ON NEUTRAL WEAK CURRENTS. Perkins, D. H. (Oxford Univ.). Mar 1974.

An introductory discussion is first given on unified theories of weak and electromagnetic interaction, leptonic neutral currents, and Weinberg model of neutral currents. The reactor experiment on $\bar{\nu}_e + e^- \to e^- + \bar{\nu}_e$ and the CERN experiment on $\nu_\mu + e^- \to e^- + \nu_\mu$ and $\bar{\nu}_\mu + e^- \to e^- + \bar{\nu}_\mu$ are then discussed. Comments are made on hadronic neutral weak currents and future possibilities for the study of leptonic neutral currents. (LBS)

25341 PHYSICS OF HIGH ENERGY NEUTRINOS. Gourdin, M. (Univ., Paris). J. Phys. (Paris), Colloq.; No. 3, 23-31(1973). (In French).

From Centenary congress on the French Physical Society; Vittel, France (28 May 1973).

The inclusive reactions induced by high energy neutrinos and antineutrinos are studied in the framework of the Fermi theory in the deep inelastic region. The notion of scaling is introduced and the consequences are discussed in the light of experimental results. Miscellaneous questions related to the existence of gauge theories like the existence of heavy leptons and charmed particles are briefly discussed. (Fr)

25342 RADIATIVE CORRECTIONS TO SEMILEPTONIC DECAY IN THE SO(3) GAUGE MODEL. Hagiwara, T. (Department of Physics, The City College of the City University of New York, New York, New York 10031). Phys. Rev. D 9: No. 10, 2813-2821 (15 May 1974).

Radiative corrections to semileptonic decay in the SO(3) gauge model are discussed with the aid of current-algebra techniques. A neutral-gluon model is taken to account for strong interactions and corrections are calculated to all orders in the gluon doupling, but only to second order in the gauge coupling e. It is proved that radiative corrections to a decay are gauge-independent and all the divergences can be removed by rescaling physical parameters and wave functions in the unrenormalized Lagrangian. (auth)

25343 VECTOR ANOMALY AND THE MAGNETIC MOMENT OF THE W-BOSON. DeRaad, L.L. Jr.; Milton, K.A.; Tsai, W. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 9: No. 10, 2847-2850 (15 May 1974).

In a unified gauge theory without heavy leptons, a possible vector anomaly (for the lepton contribution) can be precluded by an appropriate choice of basis tensors. This in turn gives a definite prediction for the weak leptonic contribution to the magnetic and quadrupole moments of the W boson. Furthermore, self-consistency (rather than convergence considerations) requires that the spectral form for the magnetic form factor in terms of the photon momentum has at least one subtraction, while that in terms of the W momentum is unsubtracted. (auth)

25344 UNIVERSAL RENORMALIZATION IN LEPTONIC AND SEMILEPTONIC AMPLITUDES. Sirlin, A. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. Lett. 32: No. 17, 966-970 (29 Apr 1974).

By use of the Ward identities of current algebra, it is shown in the context of a class of $SU(2)_L \otimes U(1)$ gauge models that, after renormalization of strong coupling constants and masses, the divergent part of the corrections of order α to the semileptonic and leptonic amplitudes mediated by the W meson is a universal multiple of the zeroth-order amplitude, independent of the strong interactions. Furthermore this divergent part can be absorbed by a universal renormalization of the W coupling constant g. (auth)

25345 $\Delta I = 1/2$ RULE FOR NONLEPTONIC DECAYS IN ASYMPTOTICALLY FREE FIELD THEORIES. Gaillard, M.K.; Lee, B.W. (National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. Lett. 33: No. 2, 108-111 (8 July 1974).

The effective nonleptonic weak interaction is examined assuming the Weinberg-Salam theory of weak interactions and an exactly-conserved-color gauge symmetry for strong interactions. It is shown that the octet part of the nonleptonic weak interaction is more singular at short distances than the $\underline{27}$ part. The resulting enhancement of the octet term in the effective local weak Lagrangian, together with suggested mechanisms for the suppression of matrix elements of the $\underline{27}$ operator, may be sufficient to account for the observed $|\Delta I| = 1/2$ rule. (auth)

25346 DIFFRACTIVE LEPTON SCATTERING AND CONSTANT σ ($e^+e^- \to$ HADRONS): A NEW REGIME IN LEPTON PHYSICS. Greenberg, O.W.; Yodh, G.B. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. Lett. 32: No. 25, 1473-1477 (24 June 1974).

We propose that extended lepton structure with size $\sim G_F^{1/2}$ leads to diffractive lepton scattering with constant σ (e^+e^-—hadrons) $\sim 2\pi G_F$. We predict that diffractive contributions to single-particle inclusive hadron distributions in e^+e^- collisions are the same as in analogous hadron collisions, and are negligible for $e^+e^- \to e^+e^-$, $e^+e^- \to \mu^+\mu^-$, $e^+e^- \to e^+e^-$ + hadrons, and eN→eX at present energies.

25347 WEAK CURRENTS AND GNOMES. Stech, B. (Heidelberg Univ. (F.R. Germany). Inst. fuer Theoretische Physik und Mechanik). Phys. Lett., B; 49: No. 5, 471-473(13 May 1974).

A weak hadronic current is constructed using fields of conventional quantum numbers. The neutral component of this current has no strangeness changing part. (auth)

25348 NEUTRAL CURRENTS IN NEUTRINO EXPERIMENT, AND LIGHT NEUTRAL INTERMEDIATE BOSON. Dolgov, A. D.; Zakharov, V. I. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 201-202(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 361-364(20 Mar 1974).

To explain the presence of neutral currents in the CERN experiment and their absence in the NAL experiment, it is suggested that the carrier of the neutral currents is a vector meson with mass m < 2 GeV. (auth)

Strong (General)

Refer also to abstracts 25416 and 25433.

25349 (GIFT-1/74) ELEMENTARY INTRODUCTION TO LOW-ENERGY STRONG INTERACTION PHYSICS: THEORY AND PHENOMENOLOGY. Alvarez-Estrada, R. F.; Carreras, B. (Junta de Energia Nuclear, Madrid (Spain)). 1974. 177p. (In Spanish). INIS.

An elementary introduction to strong interactions is presented from a point of analyticity and dispersion relations. The analyticity properties of the scattering amplitude from field theory are studied and a proof of the dispersion relations is given. A study is made of determination of the scattering amplitude from unitarity and experimental data: the phase shift analysis problem. Finally a review of the present situation of this problem is given. (auth)

25350 (GIFT-7/71, pp 118-138) HIGH ENERGY THEOREMS. Eden, R. J. (Cavendish Lab., Cambridge, Eng.). 1971.

From second GIFT seminar on theoretical physics; Madrid, Spain (5 Apr 1971).

The lectures are concerned primarily with relations between cross sections at high energies, rather than with high energy bounds. The first two lectures are of an introductory nature, and describe the use of crossing symmetry and analyticity at high energies. They include the derivation of the Pomeranchuk theorem from various assumptions. The final two lectures are concerned with the situation when these assumptions are not valid and the Pomeranchuk theorem does not hold. They will include an outline of some of the recent work on this subject which was developed following the recent experimental data on total cross sections that was obtained at Serpukhov. (auth)

25351 CONFORMAL ALGEBRAIC EXPLANATION FOR THE FAILURE OF DUAL THEORIES WITH SATELLITES. Rivers, R.J. (Physics Department, Imperial College, London S.W. 7, England). Phys. Rev. D; 9: No. 10, 2920-2922(15 May 1974).

We suggest that a dual theory with satellites corresponds to a field theory in $2k+1$ dimensions for integer $k \geq 1$ for which no infinite conformal algebra, and hence no ghost-eliminating mechanism, exists. (auth)

25352 FACTORIZATION PROPERTIES OF MULTIPION AMPLITUDE. Frampton, P.H. (Physics Department, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 9: No. 10, 2861-2864 (15 May 1974).

A previously suggested N-pion amplitude, constructed from symmetric-group (S_N) considerations, satisfies two desirable factorization properties: (i) There is bootstrap consistency at all internal pion poles in the N-point function. (ii) Using some earlier results of Schwarz, it is possible to prove that a simplified (Gervais and Neveu) version of the model factorizes with finite degeneracy for general ρ intercept $\alpha_\rho(0)$, and not only for integer values; we expect that the full model should share the same property. (auth)

25353 PERMANENTLY BOUND QUARKS—NEW SOLUTIONS TO OLD FIELD EQUATIONS. Bender, C.M.; Mandula, J.E. (Department of Mathematics, Massachusetts Intsitute of Technology, Cambridge, Massachusetts 02139); Guralnik, G.S. Phys. Rev. Lett. 32: No. 25, 1467-1470 (24 June 1974).

A class of relativistic-field-theoretic models of permanently bound quarks are shown to exhibit new and unconventional properties. They display crossing symmetry, but their Green's functions have an infinite array of singularities in momentum space and are singular everywhere in coordinate space. Nevertheless, these models are consistent quantum field theories that describe a system of interacting bound states which can decay into one another but not into quarks. (auth)

25354 THEORY OF HADRON "BAGS" WITH SCATTERING. Wu, T.T.; McCoy, B.M. (Gordon McKay Laboratory, Harvard University, Cambridge, Massachusetts 02138); Cheng, H. Phys. Rev. D 9: No. 12, 3495-3500 (15 June 1974).

We derive the boundary conditions satisfied by a boson field in the theory of hadron "bags." The scattering problem, the fission problem, and the fusion problem in this theory of one spatial dimension are discussed. (auth)

25355 NEW EXTENDED MODEL OF HADRONS. Chodos, A.; Jaffe, R.L.; Johnson, K.; Thorn, C.B.; Weisskopf, V.F. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 9: No. 12, 3471-3495 (15 June 1974).

We propose that a strongly interacting particle is a finite region of space to which fields are confined. The confinement is accomplished in a Lorentz-invariant way by endowing the finite region with a constant energy per unit volume (B). We call this finite region a "bag." The contained fields may be either fermions or bosons and may have any spin; they may or may not be coupled to one another. Equations of motion and boundary conditions are obtained from a variational principle. The confining region has no dynamical freedom but constrains the fields inside: There are no excitations of the coordinates determining the confining region. The model possesses many desirable features of hadron dynamics: (i) a parton interpretation and presumably Bjorken

scaling; the confined fields are free or weakly interacting except close to the boundary; (ii) infinitely rising Regge trajectories as a consequence of the bag's finite extent; (iii) the Hagedorn degeneracy or limiting temperature; (iv) all physical hadrons are singlets under hadronic gauge symmetries. For example, in a theory of fractionally charged, "colored" quarks interacting with colored, massless gauge-vector gluons, if both quark and gluon fields are confined to the bag, only color-singlet solutions exist. In addition to establishing these general properties, we present complete classical and quantum solutions for free scalars and also for free fermions inside a bag of one-space and one-time dimension. Both systems have linear mass-squared spectra. We demonstrate Poincaré invariance at the classical level in any dimension and at the quantum level for the above-mentioned explicit solutions in two dimensions. We discuss the behavior of specific solutions in one and three space dimensions. We also discuss in detail the problem of fermion boundary conditions, which follow only indirectly from the variational principle. (auth)

25356 DUAL SCATTERING OF PARTICLES AND POMERANCHUKONS. Clavelli, L. (Center for Theoretical Physics and Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 9: No. 12, 3449-3455 (15 June 1974).

We propose an SU(1, 1) -invariant vertex for the emission of Pomeranchuk resonances in the generalized Veneziano model. Known amplitudes for the decay of spin-l Pomeranchukons on the leading trajectory are recovered and an integral representation is given for multi-Pomeranchukon-Reggeon N-point functions. The Regge limits of elastic Pomeranchukon-particle scattering are investigated. Applications to inclusive reactions are suggested. (auth)

25357 WHY DOES THE POMERON APPEAR TO FACTORIZE?. Pumplin, J. (Department of Physics, Michigan State University, East Lansing, Michigan 48824); Kane, G.L. Phys. Rev. Lett. 32: No. 17, 963-966 (29 Apr 1974).

Numerous model calculations suggest that hadron elastic, diffractive production, and inclusive amplitudes should obey factorization numerically at a level of accuracy somewhat better than has yet been tested by experiment, but that those amplitudes will not obey the exact factorization in functional form associated with a pure Regge pole. (auth)

25358 QUARK STATISTICS AND OCTONIONS. Günaydin, M.; Gürsey, F. (Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. D 9: No. 12, 3387-3391 (15 June 1974).

It is suggested that quark fields could be regarded as transverse octonionic fields. The resulting scheme unifies the existing three-triplet quark models within an "exceptional" paraquark scheme. We give a new reason for the observability of singlet states of the exact SU(3) group of three-triplet quark models and the nonobservability of quarks and diquarks. (auth)

25359 SIMPLE CONSTRUCTION OF THE PHYSICAL-STATE PROJECTION OPERATORS IN DUAL MODELS. Ramond, R. (Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. D 9: No. 12, 3427-3430 (15 June 1974).

We present a simple way of understanding the Brink-Olive projection operators by relating them to the light-cone Hamiltonian. (auth)

25360 QUANTUM THEORY OF DUAL RELATIVISTIC PARASTRING MODELS. Ardalan, F. (Department of Physics, Arya-Mehr University, Tehran, Iran and Department of Physics, Yale University, New Haven, Connecticut 06520); Mansouri, F. Phys. Rev. D 9: No. 12, 3341-3357 (15 June 1974).

We paraquantize the classical massless relativistic-string action and find that the resulting theory is Poincaré-invariant in four space-time dimensions if we use para-Bose commutation relations of order 12. More generally, we find that if the dimension D of the space-time and the order q of parabosons are related by the expression $D = 2 + 24/q$, then the quantized theory is Poincaré-invariant. We also construct a fermionic parastring model which is the analog of the Ramond-Neveu-Schwarz model and find that it is invariant in D dimensions if $D = 2 + 8/q$, both the fermions and the bosons being of order q. We show by explicit Klein transformations that these theories are equivalent to "color"-endowed canonically quantized strings with SO(q - 1) "color" symmetry. We obtain dual tree amplitudes by suitable choice of vertices. Finally, we consider second-quantized parastring theories and show, by an explicit example, that they can be Poincaré-invariant in four space-time dimensions. (auth)

25361 π-η DEGENERACY PROBLEM IN GAUGE THEORIES. Bars, I. (Institute for Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305); Halpern, M.B. Phys. Rev. D 9: No. 12, 3430-3438 (15 June 1974).

The quark mass matrix appears to give an inadequate description of hadron symmetry breaking. Already, for pseudoscalar masses, such an approach predicts $m_\pi = m_\eta$. We show one resolution of this old problem in terms of the explicit strong dynamics and the current s of the M-gauge models. We also discuss a second possible mechanism, applicable to a quark or M model, which generates a calculable breaking as a radiative correction in one loop. This second mechanism depends only on the dynamics of the weak interactions. (auth)

25362 DIFFRACTION DISSOCIATION PROCESSES AT HIGH ENERGIES. Gramenitskii, I.M.; Novak, Z. (Joint Institute for Nuclear Research, Dubna). Sov. J. Part. Nucl. 5: No. 1, 25-46 (July 1974).

The review presents experimental data on diffraction dissociation processes. Identification methods, principal characteristics, and the possible mechanism of these processes are discussed. (auth)

25363 COLORED GLUONS, BJORKEN SCALING AND QUARK CONFINEMENT. Fritzsch, H.; Minkowski, P. (California Inst. of Tech., Pasadena (USA)). Phys. Lett., B; 49: No. 5, 462-464 (13 May 1974).

The logarithmic violations of scaling in the canonical gauge field theory of colored quarks and gluons are investigated. Upper bounds for the quark-gluon coupling constant are derived. (auth)

25364 SECOND-ORDER INTERFERENCE AS A TOOL FOR THE DETERMINATION OF HADRON FIREBALL DIMENSIONS. Cocconi, G. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 49: No. 5, 459-461(13 May 1974).

Correlations between identical particles emitted simultaneously in hadron collisions can be used to determine the dimensions of the region where the secondaries are produced. The method is similar to that used by radio-astronomers to measure the angular dimensions of sources. (auth)

25365 ON QUARK MOLECULES. Dolgov, A. D.; Okun, L. B.; Zakharov, V. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). Phys. Lett., B; 49: No. 5, 455-458(13 May 1974).

The nonrelativistic quark model with three triplets and an octet of colored gluons is examined. The interaction energy corresponding to certain quark molecules is calculated. It is shown that systems of $qq\bar{q}\bar{q}$ and $qqqq\bar{q}$ are more strongly bound than $q\bar{q}$ and qqq. Thus in order for the model to be valid there must exist exotic particles. (auth)

25366 LIMITS ON IMPACT PARAMETERS ON INELASTIC PROCESSES. Webber, B. R. (Cambridge Univ. (UK). Cavendish Lab.). Phys. Lett., B; 49: No. 5, 474-476(13 May 1974).

Rival models of multiparticle production differ widely in their predictions of the relation between final-state multiplicity and initial-state impact parameter. Most geometrical models (and intuition) suggest that larger multiplicities are associated with more central collisions, but multiperipheral models make the opposite prediction, that larger multiplicities correspond to larger impact parameters. The only way to resolve between these two types of behavior is to obtain some experimental information on the impact parameters of individual exclusive processes. It is shown here that the uncertainty principle provides a lower limit on the mean square impact parameter in terms of measurable properties of the final state. If multiperipheral models are correct, this lower limit should be close to the true value, and it should increase almost linearly with the final-state multiplicity. Thus there is a good chance that experimental measurements of this quantity for a variety of processes and energies will clarify the mechanisms of particle production. (auth)

25367 FAST SCALING IN THE MULTIPERIPHERAL MODEL. Gendenshtein, L. E. (Physical-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 19: No. 2, 84-87(Aug 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 2, 139-142(20 Jan 1973).

A simple rule is formulated that explains naturally all the experimental data on fast scaling by using only the principal premises of the multiperipheral model. The rule states that the quantum numbers of the $a\pi\bar{c}$ system must be non-exotic. (LBS)

25368 THERMODYNAMIC METHOD OF CALCULATING MULTIPERIPHERAL DIAGRAMS. Dubovikov, M. S. (Physical-Technical Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 206-208(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 371-376(20 Mar 1974).

It is shown that the differential cross section corresponding to a multiperipheral diagram with exchange of Regge trajectories between heavy blocks can be represented in a form analogous to the microcanonical distribution in thermodynamics. The methods of thermodynamics can therefore be used quite effectively to calculate different distributions and fluctuations. By way of example, a diagram with π-exchange between irreducible blocks is considered. The total and topological cross sections are calculated. (auth)

25369 FEASIBILITY OF DIRECT STUDY OF THE CHARACTER OF STRONG INTERACTIONS AT SHORT DISTANCES IN EXPERIMENTS ON e^+e COLLISIONS. Role of Quasilocal Terms. Ginzburg, I. F. (Inst. of Mathematics, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 224-226(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 413-418(20 Mar 1974).

The amplitude, which is determined only by the character of the interaction at short distances, can be measured directly in experiments on deep inelastic ee scattering (virtual forward $\gamma\gamma$ scattering). The form of the amplitude depends essentially on the character of the quasilocal (contact) terms. The possible form of the amplitude is discussed for models in which the strong interaction is turned off at short distances, and in a model in which this interaction is scale-invariant. (auth)

25370 MULTIPLICITY DISTRIBUTIONS IN HIGH ENERGY HADRONIC COLLISIONS. Frazier, W. R. (Univ. of California, La Jolla). Ann. N.Y. Acad. Sci.; 229: 193-206(20 May 1974).

Multiplicity distributions of hadrons produced in high energy collisions are fitted using the short-range correlation model and the two-component model in which both short-range correlation and diffraction production are present. The interpretation of the diffractive component in terms of Pomeron exchange in a multiperipheral picture is discussed. (LBS)

25371 MANY-BODY APPROACHES TO PARTICLE PRODUCTION AT HIGH ENERGIES. Bander, M. (Univ. of California, Irvine). Ann. N. Y. Acad. Sci.; 229: 78-90(20 May 1974).

Three methods are presented that have been borrowed from statistical mechanics for the study of multiparticle production of high energies. These are the statistical-thermodynamic model of Hagedorn and Frautschi, the hydrodynamic model of Landau, and the analogy with particle distributions in a fluid developed by Feynman. The first two are direct models for production mechanisms while the third is a guide to viewing the data as suggested by certain models and by statistical mechanics. (LBS)

25372 DYNAMICAL ISSUES IN HADRON PHYSICS. Abarbanel, H. D. I. (National Accelerator Lab., Batavia, IL). Ann. N. Y. Acad. Sci.; 229: 53-63(20 May 1974).

Two topics in hadron dynamics are discussed. The first is diffraction scattering and the view of the Pomeranchuk or vacuum singularity in the complex angular momentum plane. The second topic discussed concerns the attempts to find a space–time description of a spatially extended or composite hadron. This is carried out in the context of dual resonance models. (LBS)

25373 MODEL BUILDING FOR MULTIPARTICLE REACTIONS. Slansky, R. (Yale Univ., New Haven). Ann. N. Y. Acad. Sci.; 229: 64-77(20 May 1974).

The question of how to build a successful phenomenological model for the single-particle inclusive spectra is considered. The fluctuation analysis approach to model building is then discussed. (LBS)

25374 NUMERICAL INVESTIGATION OF HIGHLY INELASTIC REACTIONS IN A φ^3 LADDER MODEL. Bopp, F. W. Urbana, IL; University of Illinois (1973). 54p. University Microfilms Order No. 74-5530.

Thesis (Ph. D.).

Detailed numerical studies are made of a simple multiperipheral model, the φ^3 ladder model. Features relevant for the phenomenological analysis of highly inelastic reactions are examined. The first part of the thesis deals with inclusive spectra. The purpose is to obtain a better understanding of general features of the spectra and to test the approximations of existing calculations. Some attention is given to the problem of representing the new type of data. Many details of the one and two-particle spectra and the two-particle correlation function are presented. Of special significance might be the transverse momentum dependence of the one-particle spectrum and the short range structure in the correlation function in the longitudinal rapidities. The second part of the thesis investigates the convergence of Campbell and Chang's sum rules for exclusive spectra. The applicability of this method depends critically on this convergence and it is our intention to test this question in a simple nontrivial model. This seems worthwhile since a final decision cannot be reached from machine energies presently available. (Diss. Abstr. Int., B)

Strong (Baryon No. = 0)

Refer also to abstract 25293.

25375 (BNL-19012) REVIEW OF SPIN-PARITY ANALYSES OF $\pi\omega$ AND $K\omega$ SYSTEMS. Chung, S. U. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 16p. (CONF-740408-5). Dep. NTIS $4.00.

From 4th international conference on experimental meson spectroscopy; Boston, Massachusetts, USA (26 Apr 1974).

A review is given of the progress in spin–parity analyses on the $\pi\omega$ system near the threshold. Also first attempts at similar analyses on the $K\omega$ system near the threshold are presented, and its production and decay properties compared with those near the $\pi\omega$ system. (JFP)

25376 (JINR-E2-8097) LOW ENERGY SCATTERING OF MASSIVE PIONS. II. Pervushin, V. N.; Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

An analysis is carried out of the $\pi\pi$ -scattering derived earlier within the chiral quantum field theory scattering lengths and effective-range parameters are calculated for all $\pi\pi$ partial waves. (auth)

25377 NECESSARY AND SUFFICIENT CONDITIONS FOR THE ADLER ZERO. Bessler, L.; Davies, P.T. (Department of Physics, Queen Mary College, University of London, London E1 4NS, England). Phys. Rev., D; 9: No. 10, 2923-2925(15 May 1974).

By examination of several chiral Lagrangian models, for both massless and massive pions, we obtain necessary and sufficient conditions for the existence of the Adler zero in the $\pi\pi$ scattering amplitude. (auth)

25378 DUAL PION MODEL WITH ZERO INTERCEPT AND NINE DIMENSIONS. Kaku, M. (Department of Physics, The City College of the City University of New York, New York, New York 10031). Phys. Rev. D 9: No. 10, 2850-2855 (15 May 1974).

The recent work of Gervais and Neveu is a promising way of building dual models with intercept not equal to one, yet preserving the gauges of Virasoro. In this work, we generalize their work to include the dual pion model. We give an explicit form for the four-point function. We find that, like the original model, Regge behavior is broken. Furthermore, we find that the lowest-mass meson has even G parity and is therefore not a likely candidate for the pion. (auth)

25379 APPLICATION OF MOFFAT'S PION–PION SCATTERING MODELS TO $\eta \to 3\pi$, $K \to 3\pi$, AND $p\bar{n} \to 3\pi$; CALCULATIONS OF DOUBLE-BETA DECAY BASED ON THE PION-CORE MODEL OF THE $\Delta(1236)$. Smith, D. M. Victoria, B. C.; Univ. of Victoria (1973). National Library of Canada, Ottawa. Thesis (Ph. D.).

Moffat's Regge pole models for pion-pion scattering are applied to the final state interactions of the annihilation at rest $\bar{p}n \to \pi^+\pi^-\pi^-$ and the decays $\eta \to \pi^+\pi^-\pi^0$, $K^+ \to \pi^+\pi^+\pi^-$, $K^+ \to \pi^+\pi^0\pi^0$, and $K^0 \to \pi^+\pi^-\pi^0$. Moffat's pion-pion scattering models display proper Regge behavior, are crossing symmetric, and satisfy approximate unitarity over a fairly wide energy range. The pion-pion scattering models are extended to the above processes by applying crossing and by extrapolating the mass of one of the pions from its mass shell, without changing any of the parameters of the models. For the process $\bar{p}n \to \pi^+\pi^-\pi^-$ fairly good agreement with the experimental data is obtained in the range in which unitarity is satisfied. In the η and K decays the predictions are in good agreement with experiment over the entire range of available energies. In the η decay it is found that Moffat's models give better agreement when using the Regge trajectory function proposed by Lovelace. Double-beta decay based on a pion-core model of the $\Delta(1236)$, the pion-nucleon resonance with $J = I = 3/2$ is considered. It is assumed that nuclei contain a small probability admixture of the $\Delta(1236)$, and that the $\Delta(1236)$ disassociates into a pion and a core particle. This model is applied to no-neutrino and two-neutrino double-beta decay. The calculation of no-neutrino double-beta decay involves a lepton nonconserving first-order superweak process. Comparison of the theoretical half-life of ^{130}Te with the experimental value indicates that if such an interaction exists then its coupling strength is about $10^{-12.9}$ times the usual weak coupling strength. Also considered is two-neutrino double-beta decay induced by a doubly-charged muon-electron current which violates the usual lepton number scheme but satisfies the Konopinski-Mahmoud scheme. In this process an electron and an off-shell muon are produced. The muon then undergoes its usual decay into an electron, an electron antineutrino, and a muon neutrino. Comparison of the predicted half-life to the experimental value for ^{130}Te requires that the coupling strength of this interaction be about $10^{1.7}$ times the usual coupling strength in order to account for double-beta decay. But previous muon capture experiments indicate that the strength is less than 10^{-3} times the usual coupling strength. Thus this process does not contribute significantly to double-beta decay. Two neutrino double-beta decay based on conventional pionic and leptonic currents is also considered. If the probability admixture of the $\Delta(1236)$ in the nucleus is left in the calculation as a parameter, then it is found that a probability of about 1.4% produces the observed half-life

of ^{130}Te. This is a reasonable value for the probability of the $\Delta(1236)$, thus this process may contribute significantly to double-beta decay. (Diss. Abstr. Int., B)

25380 POLARIZATION FROM SCATTERING POLARIZED SPIN-1 PARTICLES ON UNPOLARIZED SPIN-1 PARTICLES. Terrall, T. L. Columbus, OH; Ohio State Univ. (1974). 263p. University Microfilms Order No. 74-17,263.

Thesis (Ph. D.).

The elastic scattering of a beam of spin-1 particles, in any state of polarization, by an unpolarized target of spin-1 particles is described nonrelativistically in terms of the transition matrix; the only assumptions made are the conservation of energy, linear momentum, angular momentum, and parity, together with time reversal invariance and, in the situation of identical particles in the beam and target, the Pauli exclusion principle. The most general form of the transition matrix which conserves parity is developed. It has 41 independent elements which form the set $\{m_i\}$ and are functions of scattering angle and energy. The 16 independent linear relations between the elements $\{m_i\}$ imposed by time reversal invariance are developed. It is shown that for identical particles the Pauli exclusion principle implies that 16 of the elements $\{m_i\}$ are zero, leaving 17 independent elements in the transition matrix. The angle dependence of the elements $\{m_i\}$ is given in terms of spherical harmonics and collision matrix elements. The collision matrix elements are given a phase shift parametrization, with the eigenphase shift parameters and the mixing parameters being functions of energy. The transition matrix, which is invariant to space reflection and time reversal, is expanded in terms of a set of 25 Cartesian spin operators which have the same properties. The 25 coefficients in the expansion form the set $\{B_i\}$ and they are functions of scattering angle and energy. In the situation of identical particles the transition matrix is additionally invariant to particle exchange and 8 of the above operators are not needed. The elements $\{m_i\}$ are expressed in terms of the elements $\{B_i\}$ and the inverse relations are developed. The polarizations of the scattered and the incident particles are expressed in terms of a set of 9 irreducible spherical tensor operators of ranks 0, 1 and 2. The scattered polarizations (including the differential cross section) are expressed explicitly in terms of the incident polarizations and the elements $\{m_i\}$. The properties, symmetries and traces for the matrices representing the quantities involved in this work are developed. (Diss. Abstr. Int., B)

25381 $\pi\pi$ PHASE SHIFTS CALCULATION BASED ON DERIVATIVE LAGRANGIAN MODEL. Jhung, K. S. Pittsburgh; Univ. of Pittsburgh (1973). 75p. University Microfilms Order No. 74-18,419.

Thesis (Ph. D.).

A renormalization scheme is introduced which is especially designed to handle the infinite terms arising from a given non-renormalizable (in Feynman–Dyson sense) Lagrangian. Counter terms necessary for removing divergence in Gell–Mann and Levy's Lagrangian model theory were fixed. The Padé approximant technique was used to sum the resulting renormalized partial wave perturbation series. As a consequence the unitarized partial wave amplitude for $\pi\pi$ scattering was obtained from which one could generate phase shifts, scattering lengths, and ρ-meson parameters. The calculated ρ-width is about 157 MeV at ρ-mass 780 MeV. In general the shapes of the phase shifts are in accordance with experimental results. It was concluded that the nonlinear σ-model can predict reasonable low energy behavior of the $\pi\pi$ scattering amplitudes with the aid of Padé technique and ρ-meson is generated dynamically in this scheme. (Diss. Abstr. Int., B)

Strong (Baryon No. = 1)

Refer also to abstracts 25299, 25432, and 25434.

25382 (COO-2009-71) BARYON DECIMET MASS SPLITTINGS. Lichtenberg, D. B. (Indiana Univ., Bloomington (USA). Dept. of Physics). 1974. Contract AT(11-1)-2009. 11p. (CONF-740653-1). Dep. NTIS $4.00.

From 9th symposium on particle physics; Balatonfured, Hungary (12 Jun 1974).

In the treatment of baryon mass decimet it is considered how well the baryon masses satisfy the Gell-Mann–Okubo mass formula. (JFP)

25383 (COO-2009-80) CORRECTIONS TO THE MASS AND WIDTH OF A RESONANCE. Lichtenberg, D. B. (Indiana Univ., Bloomington (USA). Dept. of Physics). 1974. Contract AT(11-1)-2009. 13p. Dep. NTIS $4.00.

A resonant amplitude is often parametrized with a Breit-Wigner having an energy-dependent width. This energy dependence usually incorporates the fact that the amplitude behaves at threshold like the momentum raised to the $2l + 1$ power, where l is the orbital angular momentum of the resonance. In this case, the mass and width of the resonance, defined in terms of the position of the pole of the amplitude, are smaller than the "mass" and "width" parameters entering the phenomenological Breit-Wigner expression. The lowest-order correction to the mass goes as the width squared, while the lowest-order correction to the width goes as the width cubed, and the corrections act to reduce the mass and width of the resonance. Applications to the $\Delta(1232)$, $\Sigma^*(1383)$, and $\Xi^*(1530)$ are given. (auth)

25384 (COO-3071-96) LOW ENERGY THEOREM FOR RADIATIVE CORRECTIONS TO PION NUCLEON SCATTERING LENGTHS. Segre, G. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 18 Jun 1974. 35p. (UPR-0032T). Dep. NTIS $4.75.

A low energy theorem is derived which allows one to calculate the radiative corrections to the pion–nucleon scattering lengths in the limit of vanishing pion mass. The effect is appreciable for the even pion isospin scattering length. (auth)

25385 (GIFT-7/71, pp 188-275) PHASE SHIFT ANALYSIS AND MESON AND BARYON RESONANCES. Donnachie, A. (Daresbury Nuclear Physics Lab., Eng.). 1971.

From second GIFT seminar on theoretical physics; Madrid, Spain (5 Apr 1971).

The treatment covers meson–nucleon scattering, the baryon spectrum, quark model classification of the baryon states, and hadronic decays of baryon resonances. (JFP)

25386 (LBL–3009) SEARCH FOR EXPERIMENTAL EVIDENCE ON EXCLUSIVE DOUBLE-POMERON EXCHANGE. Chew, D. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 46p. (CONF-740713–17). Dep. NTIS $5.50.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

Experience with single diffraction is used to motivate a proposed definition for the phase-space region of exclusive double-pomeron exchange (DPE); the definition involves two ratios of missing-mass to total energy. The kinematical implications of the proposed definition are explored through a triangle plot in Z variables–the logarithms of these ratios–and the problem of background is analyzed through a double-Regge expansion. It is shown that forthcoming NAL experiments should have no difficulty in establishing the presence or absence of exclusive double pomeron exchange. The results of previous attempts to measure DPE are reconsidered in terms of the Z variables, and it is found that the statistics accumulated to date are inadequate. Recent 205 Gev/C NAL experiments on $\pi^- p \to p\pi^-\pi^+\pi^-$ and $pp \to pp\pi^+\pi^-$ are discussed in some detail. (auth)

25387 (LBL–3048) πN DATA COMPILATION AND AMALGAMATION. Hodgkinson, D. P.; Kelly, R. L.; Cutkosky, R. E.; Sandusky, J. C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1974. Contract W-7405-eng-48. 30p. (CONF-740713–20). Dep. NTIS $4.50.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

We are compiling and amalgamating πN elastic and charge exchange scattering data in the resonance region. Preliminary results in the 1-2 GeV/c region are presented in this paper. The compilation procedure involves checking and correcting the Lovelace-Almehed 1971 data collection, as well as collecting all more recent data. Each set of compiled data of the six extant types (elastic and CEX cross sections and polarizations) is amalgamated in momentum bins about 50 MeV/c wide. The amalgamation is done by fitting a momentum and angle dependent surface to the data over a momentum range of about 3 bin widths, using the fitting surface in the central bin to shift the data into fixed angular bins at a predetermined central momentum, and then statistically combining the data in each bin. The fitting procedure takes into account normalization errors, calibration errors and resolution of beam momenta, electromagnetic corrections, and inconsistent data. The central bins and central momenta for each type of data are identical, thus reducing the number of points at which amplitudes need be calculated in a partial wave analysis program using the amalgamated data. The errors of interpolation are greatest for CEX data, since they are the least abundant, so the central momenta have been chosen to reduce the amount of interpolation of CEX data. The amalgamated data are correlated, but we have found that the correlations can be accurately parameterized in such a way that, rather than necessitating double sums over each type of data in a fitting program, they can be represented in terms of three single sums. (auth)

25388 THE REAL PART OF THE πN DIFFRACTION AMPLITUDE. Hoehler, G.; Jakob, H. P. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Theoretische Kernphysik). Z. Phys., 268: No. 1, 75-84(May 1974).

6 figs.; 35 refs.

The real part of the invariant isospin even πN amplitude $C^+ = A^{1+}$ at $|t| < \sim 0.4$ GeV/c² is determined from the condition that C^+ fulfills the fixed-t dispersion relation, is compatible with this amplitude as reconstructed from phase shifts up to 1.5 GeV/c and leads to differential cross sections above 3 GeV/c in agreement with the experimental data. The result for Re C^+/Im C^+ is remarkably large (0.5 at $t = -0.3$ (GeV/c)² and 6 GeV/c) and up to 20 GeV/c its uncertainty is comparable with that in the upper part of the phase shift region. Even at 40 GeV/c Re C^+ is far from being asymptotic because of large energy-independent low energy contributions. (auth)

25389 HERETICAL MODELS OF PARTICLE PRODUCTION. Carruthers, P. (Cornell Univ., Ithaca, NY). Ann. N. Y. Acad. Sci.; 229: 91-123(20 May 1974).

The phenomenological and theoretical description of particle production in high energy collisions is reviewed from a skeptical point of view. Evidence for flat rapidity distributions is examined and found to be much less compelling than commonly believed. It is further suggested, on the basis of Landau's hydrodynamical model, that Feynman scaling never occurs for small x. The principal process of particle production is claimed to be classical in nature, best described in configuration space. The hydrodynamical model accounts simply for pion production (also total charged secondaries) in pp collisions in a quantitative manner, unlike more popular contemporary models. In particular, a universal energy dependent scaling law is derived and shown to work down to rather low energies. The qualitative features of Landau's approach are examined and generalized. It is suggested that in ultrahigh energy collisions a new state of existence (called prematter) is created. Prematter is characterized by having many degrees of freedom, with collective behavior of the sort common in condensed matter physics but novel in particle physics. A program of twenty problems is suggested to carry out the implications of this point of view. (auth)

25390 U(VI) BARYON SPECTRUM AND U(VI) BREAKING. Ghoroku, K.; Imachi, M.; Nakano, Y. (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto); 50: No. 4, 1418-1420(Oct 1973).

It is shown that the U(6) counting of the urbaryon rearrangement diagram has a special importance when it is studied from the s-channel point of view. Possible U(6) breaking mechanisms are discussed. (JFP)

Strong (Baryon No. ≥ 2)

Refer also to abstract 25527.

25391 (ANL/HEP-7432) THEORETICAL INTERPRETATION OF EXPERIMENTS WITH POLARIZED PROTON BEAMS. Halzen, F. (Argonne National Lab., Ill. (USA)). Jun 1974. Contract AT(11-1)-881. 34p. (CONF-740226-4). Dep. NTIS $4.75.

From symposium on high energy physics with polarized beams; Argonne, Illinois, USA (8 Feb 1974).

The simplicity and transparency of the language of optics in discussing experiments with polarized beams and/or polarized targets are discussed. The assumption that spinning nucleons only interact through a spin-orbit force, supplemented with general knowledge about the impact parameter structure of the proton yields a one parameter model for all polarization parameters consistent with the available data. The relation between the s-channel optical language and the t-channel exchange language is discussed. Also possible applications to purely peripheral reactions are proposed. (auth)

25392 (COO-2009-69) THEORETICAL MODELS FOR PROTON-PROTON ELASTIC POLARIZATION. Hendry, A. W.; Abshire, G. W. (Indiana Univ. of Pennsylvania (USA). Dept. of Physics). 1973. Contract AT(11-1)-2009. 9p. Dep. NTIS $4.00.

Various models—Regge models, the Chou-Yang-Durand-Lipes model, and an optical model—are applied to proton-proton elastic polarization for $|t| \lesssim 6$(GeV/c)². Only the last model correctly predicted the regular sequence of double zeros, as is now observed in the recent polarization measurements at 12.33 GeV/c. (auth)

25393 (COO-2009-74) EVIDENCE FOR COHERENT EFFECTS IN LARGE ANGLE HADRON-HADRON SCATTERING. Hendry, A. W. (Indiana Univ. of Pennsylvania (USA). Dept. of Physics). Mar 1974. Contract AT(11-1)-2009. 14p. Dep. NTIS $4.00.

It is suggested that by looking at pp and π^+p elastic data, that the evidence for the parton prediction $d\sigma/dt \sim s^{-8}f(\theta)$ is not as convincing as is generally supposed. Also attention is drawn to the presence of well defined structures in $(d\sigma/dt)_{\theta}$; these may well reveal a strong component of conventional coherent scattering effects, even at large angles. (auth)

25394 (LA-UR-74-765) ANALYSIS OF RESULTS OF CALCULATIONS OF FEYNMAN GRAPHS FOR NUCLEON-NUCLEON SCATTERING. Gammel, J. L.; Menzel, M. T. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 15p. (CONF-740822-1). Dep. NTIS $4.00.

From conference on few body problems in nuclear and particle physics; Quebec, Canada (27 Aug 1974).

A number of Feynman graphs for nucleon-nucleon scattering were calculated using a given interaction. Also graphs for pion-nucleon scattering were calculated using the first term in this interaction. (JFP)

25395 (NP-20099) NUCLEON-NUCLEON AND LAMBDA-NUCLEON INTERACTIONS. Riska, D. O. (Helsinki Univ. of Technology, Otaniemi (Finland). Dept. of Technical Physics). 1973. 16p. Dep. NTIS (US Sales Only) $4.00.

Thesis.

An attempt is made to formulate the strong interaction between baryons in terms of a potential. (JFP)

25396 (RL-74-112) TWO COMPONENT ANALYSIS OF THE INELASTIC OVERLAP FUNCTION. Inami, T.; Phillips, R. J. N.; Roberts, R. G. (Science Research Council, Chilton (UK). Rutherford Lab.). Jul 1974. 15p. Dep. NTIS (U. S. Sales Only) $4.00.

ISR pp elastic data are analyzed, and it is shown that much of the structure of the inelastic overlap function can be attributed to absorptive effects. The "unabsorbed" function can be expressed as the sum of two exponentials (or two Gaussians in b-space) whose behaviors suggest they correspond to the diffractive and multiperipheral components of inelastic scattering. Although the net increase in cross section is peripheral, the diffractive component is essentially central. (auth)

25397 (USIP-73-22) FRAGMENTATION $p\bar{p} \rightarrow \bar{p}\Delta$ IN 9.2 GeV/c ANTIPROTON-PROTON REACTIONS. Carlsson, R.; Ekspong, G.; Holmgren, S. O.; Nilsson, S.; Stenbacka, R.; Walck, C.; Gregory, P.; Mason, P.; Muirhead, H.; Warren, G. (Stockholm Univ. (Sweden). Fysiska Institutionen). Dec 1973. 16p. (CONF-730943-18). Dep. NTIS (US Sales Only) $4.00.

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The fragmentation $p(\bar{p}) \xrightarrow{\bar{P}(P)} \Delta(\bar{\Delta})$ was shown to be very important in 9.2 GeV/c antiproton-proton reactions. A preliminary estimate of the cross section for $\Delta + \bar{\Delta}$ production gives ~10 mb. A large contribution to the $\Delta(\bar{\Delta})$-production cross section comes from the process $p\bar{p} \rightarrow pp\,\pi^+\pi^-$ with a cross section of 2.65 ± 0.02 mb. The triple-Regge pole expansion describes the approximately asymptotic part of the invariant cross section $f(t, s_x/s)$ with an effective trajectory $\alpha(t) = \alpha_\pi$ assuming the total cross section $\alpha(t)$ p → X to be dominated by the Pomeron exchange. The pion trajectory appears to be dominating the proton fragmentation to Δ. (auth)

25398 3,3 RESONANCE AND NUCLEON POLE MODEL FOR $pp \rightarrow pp\pi^0$ AND $pp \rightarrow pn\pi^+$. Borie, E. (Michigan State Univ., East Lansing (USA)); Drechsel, D. (Mainz Univ. (F. R. Germany). Inst. fuer Kernphysik); Weber, H. J. (Virginia Univ., Charlottesville (USA)). Z. Phys.; 267: No. 5, 393-398(May 1974).

9 figs.; 15 refs.; with app.

The nucleon pole and 3,3 resonance pole contributions are considered for the reactions $pp \rightarrow pp\pi^0$ and $pp \rightarrow pn\pi^+$ at low and medium incident proton energies. The total and various differential cross sections are calculated, also for polarized nucleons, and compared with experimental data. (auth)

25399 ON ANALYTIC NONLOCAL POTENTIALS. III. LOCAL CORRELATIONS. Yao, T.H. (Mathematics Department, Bedford College, London, England). J. Math. Phys. (N.Y.) 15: No. 8, 1225-1226 (Aug 1974).

We give examples of "analytic nonlocal potentials" which show local correlations for a finite range of the distance, bounded below and above. (auth)

25400 A PICTURE OF MULTIPLE-MESON PRODUCTION. Goldhaber, A.S. (Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11790). Phys. Rev. Lett. 33: No. 1, 47-51 (1 July 1974).

High-energy hadron-hadron collisions are viewed as proceeding by a strong short-range "quark-quark" interaction, generating a "spark" in the form of a self-interacting meson field, which yields observable mesons only after the incident particles have passed. This picture leads to the possibility of rare events with high multiplicity. There is a

definite contradiction to Gottfried's recent model of multiple production in nuclei, but little practical distinction for beams below 1 TeV. (auth)

25401 HADRON-NEUTRON FORWARD ELASTIC SCATTERING AMPLITUDE AND HADRON-DEUTERON COLLISIONS. Franco, V.; Varma, G.K. (Physics Department, Brooklyn College of the City University of New York, Brooklyn, New York 11210). Phys. Rev. Lett. 33: No. 1, 44-47 (1 July 1974).

Coulomb-nuclear interference in high-energy charged-hadron-deuteron collisions is treated exactly within the framework of Glauber theory. Charge-distribution effects are included. Applications are made to pd measurements below 70 GeV to extract ρ_n, the ratio of real to imaginary parts of the proton-neutron forward elastic scattering amplitude. An alternative and earlier analysis is shown to yield comparable values for ρ_n. Both results for ρ_n differ significantly from an earlier analysis. (auth)

25402 BREAKING THE HADRON STRING--QUARKS AT THE NATIONAL ACCELERATOR LABORATORY. Goldberg, H. (Department of Physics, Northeastern University, Boston, Massachusetts 02115). Phys. Rev. Lett. 32: No. 25, 1470-1473 (24 June 1974).

I consider the average displacement from its near neighbors of a parton in a hadron string after absorbing a highly virtual photon. It is found that for $Q^2 \gtrsim 60$ GeV^2, the struck parton would find itself separated from its near neighbors by a distance greater than the average internucleon spacing in a nuclear matter. I discuss the consequences of this result vis à vis deep inelastic scattering of leptons from complex nuclei. (auth)

25403 DEEP INELASTIC PROCESSES WITH HADRONIC INITIAL STATES. Jaffe, R. L. (Massachusetts Inst. of Tech., Cambridge). Ann. N. Y. Acad. Sci.; 229: 225-238(20 May 1974).

The application of deep inelastic physics to hadron-hadron interactions is discussed. $pp \to \mu^+\mu^-(Q^2)$ + anything at high energy and large Q^2 is discussed from both the parton model and light cone approach. Parton models of large angle elastic scattering, especially the interchange model of Blankenbecler, Brodsky, and Gunion, are then discussed. Also covered briefly is inclusive production of hadrons at high momenta transverse to the beams at ISR. (LBS)

25404 CHARGE-SYMMETRY BREAKING IN THE LAMBDA-NUCLEON INTERACTION. Walsted, M. C. Kingston, RI; Univ. of Rhode Island (1973). 118p. University Microfilms Order No. 74-16,881.

Thesis (Ph. D.).

Phenomenological charge-symmetry-breaking (CSB) potentials are constructed for the lambda-nucleon (ΛN) system. Previous work has assumed the CSB and charge-symmetric (CS) parts of the ΛN potentials have the same range. In the present calculations of CS and CSB ranges and shapes are allowed to be different, with a resultant improvement of the agreement between experimental low energy Λp total scattering cross sections ($\sigma_{\Lambda p}$) data and Downs's SU_3 theory of CSB. Scattering cross sections are dominated by the larger CS potential and tend to require a rather large over-all intrinsic range, (b ~ 2 F), while Downs's meson-theoretic CSB potential is dominated by vector meson exchange with a considerably shorter intrinsic range (b ~ 0.5 F). The data fitted are the experimental cross sections, the lambda separation energy of $_\Lambda H^3$, and a theoretical parameter related to the CSB effects observed in $_\Lambda H^4$ and $_\Lambda He^4$. The procedure used enables an independent variation of the CS and CSB ΛN singlet and triplet strengths. A class of ΛN potentials is thereby obtained, reflecting experimental uncertainties in the data used and different assumed CSB ranges. The use of different CSB ranges complicates the formulation of the $_\Lambda H^3$ problem, as a ΛN potential of at least second rank is required in the momentum space representation employed. The structure of $_\Lambda H^3$ is studied in detail, both in momentum space and coordinate space. Indirect evidence supporting the spin assignment of 0 to $_\Lambda H^4$ is also presented. (Diss. Abstr. Int., B)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 25759, 25767, 25772, and 25792.

25405 (IC-73-116) UNIFICATION OF THE EXTERNAL CONFORMAL SYMMETRY GROUP AND THE INTERNAL CONFORMAL DYNAMICAL GROUP. Barut, A. O.; Bornzin, G. L. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1973. 20p. INIS.

The two common applications of O(4,2) as a conformal group on external space-time co-ordinates and as a dynamical group on internal relative co-ordinates are combined into a unified algebraic structure for composite systems. A method is given for obtaining from this structure infinite-component wave equations and a discrete, linearly increasing mass spectrum. (auth)

25406 LOW ENERGY AND NUCLEAR PHYSICS, P AND T VIOLATION. Kim, C. W. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 3, 33-37(1973).

From Centenary congress on the French Physical Society; Vittel, France (28 May 1973).

A brief review of the present status on P and T invariance in strong, electromagnetic and weak interactions is presented. Emphasis is laid on the low energy and nuclear phenomena, in particular on the discussion of the parity violating nucleon-nucleon potential due to P violation in weak interactions and its effects on nuclear physics. (Fr)

25407 COUPLING BETWEEN TIME REVERSAL AND SPACE TIME-SYMMETRIES OF THE de SITTER UNIVERSE. Mallett, R.L.; Fleming, G.N. (Department of Physics, The Pennsylvania State University, University Park, Pennsylvania 16802). Phys. Rev. D 9: No. 10, 2710-2716 (15 May 1974).

We discuss timelike reflections through spacelike hyperspheres in a de Sitter universe of positive curvature as the natural generalization of timelike reflections through spacelike hyperplanes in the flat Minkowski universe. Taking into account the well-known problem concerning the eigenvalue spectrum of the generator of time displacements in the de Sitter universe we derive equations of motion for linear as well as antilinear operators of motion reversal on spacelike hyperspheres. It is shown that the entire connected component of the homogeneous de Sitter group SO(1, 4) may be constructed for either operator. (auth)

25408 INTRODUCTION TO CONFORMAL INVARIANCE. Callan, C. (Princeton Univ., NJ). Ann. N. Y. Acad. Sci.; 229: 6-16(20 May 1974).

The mechanics of conformal invariance is first discussed. A canonical treatment of the Ward identities for scale and conformal invariance is then given. The construction of conformal invariant Green's function is next treated. The question of whether the scale and conformal Ward identities are afflicted by anomalous terms is discussed in terms of the normal product method of Zimmerman. (LBS)

25409 VIEWS ON BROKEN SYMMETRY. Weinberg, S. (Massachusetts Inst. of Tech., Cambridge). Ann. N. Y. Acad. Sci.; 229: 36-44(20 May 1974).

The problem of determining the possible degrees of freedom in choosing a gauge model is first considered. The ideas of current algebra are then incorporated into the general framework of the renormalizable gauge theories of weak and electromagnetic interactions. (LBS)

Applications (Electromagnetic and Weak)

Refer also to abstracts 25271 and 25554.

25410 (COO-1545-145) RECOVERY FROM SPONTANEOUS BREAKDOWN OF CHIRAL AND GAUGE SYMMETRY IN DENSE DOMAINS OF HADRONIC MATTER. Bolzan, J. F.; Palmer, W. F. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1974. Contract AT(11-1)-1545. 13p. Dep. NTIS $4.00.

It is speculated that chiral symmetry and unified gauge symmetry of weak and electromagnetic interactions become exact and manifest in regions of high nuclear density. (auth)

25411 (DESY-74/16) TIME-REVERSAL-INVARIANCE-LIKE RELATIONS FOR SPIN-EFFECTS IN ELASTIC AND INELASTIC REACTIONS; VECTOR-MESON PHOTOPRODUCTION VERSUS COMPTON SCATTERING FROM NUCLEONS. Dass, G. V.; Fraas, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Apr 1974. 47p. Dep. NTIS (US Sales Only) $5.50.

For elastic scattering, relations between spin-effects (for example, the well-known asymmetry-polarization equality) follow from time-reversal invariance. It is shown that if certain amplitude-combinations vanish, there are strikingly similar relations between spin-effects for elastic and also inelastic reactions. This vanishing of amplitude-combinations (denoted M-purity) corresponds asymptotically to purely natural or purely unnatural parity in the crossed channel. The M-purity relations hold for spin-configurations much more general than do the corresponding time-reversal-invariance relations. The experimental evidence for purely natural parity exchanges in high energy vector meson photoproduction from nucleons is shown to be good for all amplitudes involving nonzero meson helicity, but less conclusive for the zero helicity ones. Using time-reversal-invariance and a vector meson-dominance argument, this implies no unnatural parity contributions in high energy Compton scattering from nucleons. Because of this empirical evidence for M-purity in these two processes, a detailed application to spin-effects in Compton scattering and in vector meson photoproduction is made. (LBS)

25412 K^0 MESON PHYSICS, CP VIOLATION, AND SELECTION RULES. Vannucci, F. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 3, 39-47(1973). (In French).

From centenary congress on the French Physical Society; Vittel, France (28 May 1973).

The recent results obtained in the different decays of the K^0 meson are used to review the present experimental situation concerning both the violation of CP and the selection rules $\Delta S = \Delta Q$ and $\Delta I = \frac{1}{2}$. (FR)

25413 GAUGE MODEL FOR CHIRAL-SYMMETRY BREAKING AND MUON-ELECTRON MASS RATIO. Mohapatra, R.N. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 9: No. 12, 3461-3466 (15 June 1974).

We present a unified gauge model of weak and electromagnetic interactions, which has the following features: (a) Chiral $U(2)_L \times U(2)_R$ is an exact "natural" symmetry of strong interactions in zeroth order and therefore its violations (which arise in order g^4) are computable, and adjusting parameters suitably we can get $(\sqrt{2}\,\epsilon_0 + \epsilon_8)/(\sqrt{2}\,\epsilon_0 - 2\epsilon_8) \sim \alpha$; (b) violations of isospin symmetry as observed in, for example, $\Delta I \neq 0$ mass differences are, then, computable and of order α; (c) this model can be extended to include leptons in such a way that m_e/m_μ is computable and is of order g^4. We also speculate on the possibility of spontaneous CP violation arising as a higher-order effect. (auth)

25414 PARITY NONCONSERVATION EFFECTS DUE TO NEUTRAL WEAK CURRENTS IN MESIC ATOMS. Moskalev, A. N. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 216-218(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 394-398(20 Mar 1974).

P-odd correlation produced in the single-quantum transition $2S_{\frac{1}{2}} \rightarrow 1S_{\frac{1}{2}}$ for mesic atoms as a result of parity-violating interaction of neutral weak muon and nucleon currents is considered. These correlations include the circular polarization of the γ quanta and the asymmetry of emission of the γ quanta relative to the residual polarization of the muons. It is shown that mesic atoms with $1 < Z \lesssim 10$ are more convenient for the experimental observation of these correlations. (auth)

Applications (Strong)

25415 UNIFIED PICTURE OF THE ALGEBRA OF STRENGTHS, $SU(6)_W^{currents}$, AND $SU(6)_W^{strong}$. Gomberoff, L.; Horwitz, L.P. (Department of Physics and Astronomy, Tel Aviv University, Tel Aviv, Israel); Ne'eman, Y. Phys. Rev. D 9: No. 12, 3545-3561 (15 June 1974).

A unitary transformation is introduced which carries the entire set of integrated local current densities generating the group $[U(6) \times U(6)]_{SW^{currents}}$ [with diagonal subgroup $SU(6)_W^{currents}$] into a newly defined $[U(6) \times U(6)]_{SW^{strong}}$ [with diagonal subgroup $SU(6)_W^{strong}$] which commutes with the boost in the z direction and with the free-field Hamiltonian. Strong current-hadron scattering amplitudes are constructed and analyzed in the deep Regge region in order to extract the hadron couplings to vector and tensor Regge exchanges. This analysis is based upon a canonical algebra of strong bilocal currents which is not equivalent to the bilocal algebra of the current system. (auth)

25416 PHASE TRANSITIONS IN VECTOR-GLUON MODELS: A SOLUTION TO THE U(3) PROBLEM. Langacker, P.; Pagels, H. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 9: No. 12, 3413-3427 (15 June 1974).

We have examined the realizations of chiral symmetry in the Abelian vector-gluon model, in the absence of gluon self-energy. The chiral symmetry is broken spontaneously in the vacuum. A vacuum stability condition on the gluon coupling g and the gluon-fermion mass ratio μ/m of the form $f_\pi^2(g^2, \mu^2/m^2) > 0$ is obtained as a necessary condition for a Nambu-Goldstone realization with bound-state Goldstone bosons. Here f_π is the decay constant of the bound-state Goldstone boson. It is shown that for those channels that do not communicate with pairs of vector gluons this condition is satisfied in the weak-coupling limit, $g^2 \rightarrow 0$. For axial-vector-currents that satisfy anomalous Ward identities and communicate with pairs of gluons we show that the renormalized integral equations for f_π^2 do not possess solutions. The failure to find a Goldstone solution for these channels is associated with the fact that axial-vector currents have an anomalous dimension greater than three. Instead of Goldstone bosons one finds that axial-vector-current conservation breaks down and the symmetry is broken explicitly. Hence, there is no Goldstone boson associated with "axial baryonic charge." This also answers in the negative the old question of whether electrodynamics can support a Goldstone mode. We also calculate g_A-1 to order g^2 and discuss phase transitions between the Wigner-Weyl mode, the Goldstone mode, and the mode in which the symmetry is explicitly broken. We also speculate on the implications of this work for gauge theories of the strong interactions. (auth)

Scattering Theory

Refer also to abstract 25766.

25417 (COO-3071-97) DERIVATION OF RELATIVISTIC THREE-DIMENSIONAL FORMALISMS FROM THE BETHE-SALPETER EQUATION. Klein, A.; Lee, T. S. H. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 29 May 1974. 18p. (UPR-0034N). Dep. NTIS $4.00.

A theoretically complete relativistic three-dimensional formalism was first derived from the Bethe-Salpeter equation by Levy, Klein, and Macke. Two new derivations of this work are given with the aim of clarifying its close connection but nonidentity with various popular alternative formalisms of more recent vintage. Insofar as possible the merits of the various formalisms are presented. (auth)

25418 (GIFT-7/71, pp 6-34) RIGOROUS CONSEQUENCES OF ANALYTICITY AND UNITARITY. Martin, A. (CERN, Geneva). 1971.

From second GIFT seminar on theoretical physics; Madrid, Spain (5 Apr 1971).

Lectures are given on the analyticity of the S matrix starting with the general principles of quantum field theory coupled with the physical requirement of unitarity of the S matrix. Unitarity and positivity conditions, the extension of the axiomatic analyticity domain, and bounds are considered. (JFP)

25419 (GIFT-7/71, pp 35-79) MANDELSTAM REPRESENTATION: DERIVATION, EXISTENCE PROOF, AND COMPUTATION. Atkinson, D. (Univ., Bonn). 1971.

From second GIFT seminar on theoretical physics; Madrid, Spain (5 Apr 1971).

The origins of the Mandelstam representation are explained. Some proofs that there exist functions with Mandelstam analyticity that satisfy crossing and elastic unitarity at the same time are discussed. Some of the properties of linear integral equations with Cauchy singularities are mentioned. (JFP)

25420 (GIFT-7/71, pp 80-117) EXACT PROPERTIES OF PION-PION AMPLITUDES. Wanders, G. (Univ., Lausanne, Switzerland). 1971.

From second GIFT seminar on theoretical physics; Madrid, Spain (5 Apr 1971).

An extended version of lectures, given to describe some of the known rigorous properties of the pion-pion scattering amplitudes resulting from axiomatic field theory, include physical region constraints of the $\pi^0\pi^0$ amplitude and other isospin combinations, unphysical region constraints of crossing conditions, positivity, and their combination, and models of pion-pion scattering. (JFP)

25421 (GIFT-7/71, pp 139-187) ASYMPTOTIC PROPERTIES OF SCATTERING AMPLITUDES AND THEIR EXPERIMENTAL CONSEQUENCES. Eden, R. J.; Kaiser, G. D. (Cavendish Lab., Cambridge, Eng.). 1971.

From second GIFT seminar on theoretical physics; Madrid, Spain (5 Apr 1971).

Bounds are obtained on the asymptotic behavior of scattering amplitudes that violate the Pomeranchuk theorem and correspond to asymptotically constant total cross sections. It is proved that the differential cross sections have forward peaks whose height grows like $B \ln^2(s)$ and whose width shrinks like $B' \{\ln(s)\}^{-2}$. It is proved that the amplitudes have zeros in the region $|t| \sim B''\{\ln(s)\}^{-2}$, and bounds are obtained on the constants B, B', B''. A range of possible experimental consequences is studied, and it is found that interference between Coulomb interactions and strong interactions plays a major role in determining whether the new theoretical results can be observed in practice. A narrow strong peak in the Coulomb region cannot be excluded and may invalidate some experimental procedures for obtaining the phase of forward amplitudes and total cross sections. (auth)

25422 (ITF-74-2P) PROOF OF THE JOST-LEHMAN-DYSON INTEGRAL REPRESENTATION FOR CAUSAL COMMUTATOR WITHIN THE FRAMEWORK OF LOCALIZABLE THEORY. Lazur, V. Yu.; Khimich, I. V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 31p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

The Jost-Lehman-Dyson integral representation is proved within the framework of theory admissing the growth of matrix elements of causal commutator in the momentum space no stronger than any linear exponential. In this case the theory of tempered distributions and also the strictly localizable theories of Jaffe are the specific cases of the localizable theory under consideration. The integral representation proved can be used for proving the analytic properties of the scattering amplitude in the S plane as well as the dispersion relations within the framework of the localizable theories. (auth)

25423 (RL-74-038, pp I.1-I.40) INTRODUCTORY NOTES ON PHASE SPACE. Jones, G. T. Mar 1974.

An attempt is made to arrive at a relativistic generalization of "Fermi's Golden Rule" in such a way as to make clear what is kinematics (or phase space) — so that the dynamics can be factorized off as well as is possible. Then comes an introduction to several kinematical plots which are useful for looking at the data, followed by a discussion of the limitations of such plots. In conclusion, an analysis which is reasonably free of reflections is mentioned briefly. (LBS)

25424 (RL-74-038, pp V.1-V.15) INTRODUCTION OF ANALYTICITY INTO PHYSICS. Jones, G. T. Mar 1974.

An introduction is given to some of the concepts which lead from quantum mechanics to S-matrix theory. It is shown that some of the concepts of S-matrix theory have analogs in potential scattering and field theory. (LBS)

25425 THE T OPERATOR AND AN INVERSE PROBLEM FOR NONLOCAL POTENTIALS. Yao, T.H. (Department of Physics and Astronomy, University College, London, England). J. Math. Phys. (N.Y.) 15: No. 8, 1227-1231 (Aug 1974).

For a class of short-ranged nonlocal potentials, the T operator T(k) is studied in the region Imk > $-\gamma$, where $1/\gamma$ is the range of the potential. Inversion formulas are obtained which determine the potential from $t(E) = T(\sqrt{E})$, for any real E, for which t(E) is defined, perhaps with the exception of a countable set of points. (auth)

25426 HAAG-RUELLE APPROXIMATION OF COLLISION STATES. Buchholz, D. (Hamburg Univ. (F. R. Germany). 2. Inst. fuer Theoretische Physik). Commun. Math. Phys.; 36: No. 3, 243-253(Apr 1974).

7 refs.

We investigate the rate of convergence of the Haag-Ruelle approximation $\psi(t)$ at large times t for arbitrary collision states ψ with finite energy. An improved estimate of the norm distance $\psi-\psi(t)$ is given. In particular for states ψ with smooth asymptotic wave functions it turns out that $\psi-\psi(t)$ approaches 0 almost like $t^{-\frac{1}{4}}$. (auth)

25427 COMMENT ON A NEW METHOD FOR PHASE SHIFT COMPUTATION. Kowalski, K.L. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. C 10: No. 1, 366-368 (July 1974).

A method for computing phase shifts recently proposed by Bolsterli based upon a new nonsingular scattering integral equation is shown to be a special case of the so-called generalized Sasakawa technique. This observation leads to a simplification of the practical exploitation of the method as well as an extension to the calculation of half-off-shell amplitudes. (auth)

25428 ACCURATE MOMENTUM-SPACE METHOD FOR SCATTERING BY NUCLEAR AND COULOMB POTENTIALS. Vincent, C.M.; Phatak, S.C. (University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. C 10: No. 1, 391-394 (July 1974).

A coordinate-space boundary-matching method is used to solve the problem of including the long-range Coulomb interaction in momentum-space calculations of elastic scattering. (auth)

25429 ANALYTIC SOLUTIONS IN CONFIGURATION SPACE REPRESENTATION FOR SCATTERING FROM A CLASS OF SEPARABLE NONLOCAL POTENTIALS. Bagchi, B.; Mulligan, B. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. C 10: No. 1, 126-135 (July 1974).

In this paper we consider scattering of all partial waves from a wide class of separable nonlocal potentials and obtain in configuration space exact analytic expressions for the wave functions and phase shifts. These expressions simplify some of the difficulties associated with finding a potential which fits phase shift data, with the analytic expressions for the scattering length and effective range being particularly useful. Employing these results, we obtain a two-term separable nonlocal potential with three adjustable parameters which gives a reasonable fit to the $^1S_0$ n-p phase shifts and a very good scattering length and effective range. (auth)

25430 METHOD FOR PROOF OF ASYMPTOTIC THEOREMS IN PRESENCE OF OSCILLATIONS. Grunberg, G.; Truong, T.N. (Centre de Physique Théorique de l'Ecole Polytechnique, 17, rue Descartes 75230 Paris-Cedex 05 France). Phys. Rev. D 9: No. 10, 2874-2893 (15 May 1974).

A simple method is derived which gives the asymptotic behavior of the forward scattering amplitude directly on the physical cut without any restriction on the nature of oscillations. Applications are given to high-energy theorems such as the Pomeranchuk theorems and consequences deduced from unitarity. Using the phase representation and the method developed, a number of results due to Khuri and Kinoshita, Jin and MacDowell, and Bessis and Kinoshita are derived and improved. (auth)

25431 ASYMPTOTIC BEHAVIOR OF SPIN-DEPENDENT FEYNMAN INTEGRALS: FOURTH-ORDER SPINOR-VECTOR SCATTERING. Prum, S. (Department of Physics and Astronomy, Tel-Aviv University, Ramat-Aviv, Israel). Phys. Rev. D 9: No. 12, 3528-3544 (15 June 1974).

Several methods for obtaining the leading and subleading asymptotic dependence of the fourth-order spinor-vector scattering are considered. Under the assumption of equal masses, $s = 0$, and large t, the nonpolynomial asymptotic expansion for the helicity-dependent amplitude is evaluated and shown to consist of terms proportional to $t^{-n}\ln t + t^{-m}(\ln t)^2$, where $n \geq 0$ and $m \geq 1$. The origin of terms quadratic in lnt is discussed as an example of the singularity-enhancing properties of spin and it is shown that a possible mechanism for the enhancement effects is through the introduction of subtractions to the dispersion relations of the theory. (auth)

25432 REGGE BEHAVIOR AND DAUGHTER DEGENERACIES IN FOURTH-ORDER SPINOR-VECTOR SCATTERING. Prum, S. (Department of Physics and Astronomy, Tel-Aviv University, Ramat Aviv, Israel). Phys. Rev. D 9: No. 12, 3517-3527 (15 June 1974).

For the equal-mass scattering of spin-1/2 nucleon and neutral vector mesons, we discuss the Regge behavior of the amplitude and consider the questions posed by the existence of degenerate daughter trajectories within the framework of fourth-order perturbation theory. A formalism for the identification of daughter contributions is developed and the algebraic solution to the equations constraining the residues of the daughters is presented. By applying these ideas to the results of a previous calculations, we find that, while to fourth order sufficient information exists to resolve the degeneracy and to test for its breaking, the daughter contributions cannot be clearly identified due to the presence of new singularities having the form $t^{-1}\ln^2 t$ to fourth order. The possible origin of these terms is discussed and is tentatively ascribed to the existence of fixed poles of order three at the negative half-integer values of J. (auth)

25433 CONSTRUCTION OF DUAL AMPLITUDES. Arik, M. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. D 9: No. 12, 3467-3471 (15 June 1974).

The constraints imposed on dual amplitudes and Regge trajectories by conditions of crossing, Regge asymptotic behavior, polynomial residues, and meromorphy are investigated. A general class of amplitudes satisfying these conditions is constructed. Its relation to existing dual models and a closely related nonmeromorphic class of amplitudes which indicate composite hadron structure are then discussed. (auth)

25434 STATIC MODELS IN THE DISPERSION APPROACH. Zhuravlev, V.I.; Meshcheryakov, V.A. (Joint Institute for Nuclear Research, Dubna). Sov. J. Part. Nucl. 5: No. 1, 68-88 (July 1974).

Results obtained for static models by the dispersion approach are reviewed. The emphasis is on the methods used to obtain equations for the models and on the exact solutions of these equations. Use of these models in various approximation schemes and in analyzing low-energy πN scattering is discussed. (auth)

25435 TIME-DEPENDENT SCATTERING THEORY FOR HIGHLY SINGULAR POTENTIALS. Pearson, D. B. (Univ., Geneva). Helv. Phys. Acta; 47: No. 2, 248(1974).

Asymptotic completeness of the wave operators is proved for scattering of a particle by a wide class of highly singular short-range potentials, which may be either attractive or repulsive. (auth)

25436 NEW METHOD FOR THE GENERAL SOLUTION OF PARTIAL-WAVE DISPERSION RELATIONS. Nenciu, G.; Rasche, G.; Woolcock, W. S. (Univ., Zurich). Helv. Phys. Acta; 47: No. 2, 137-162(1974).

A new method is described for obtaining explicit solutions, of a very general type, of a partial-wave dispersion relation for arbitrary l in which the left-hand singularities are replaced by a finite set of poles. The solutions are given by a representation theorem as the product of a Herglotz function and the quotient of two polynomials. Various conditions are obtained for solutions to exist. The special cases of $l = 0$ and one pole and of $l = 1$ and two poles are worked out fully. (auth)

25437 SOFT PHOTON THEOREM IN POTENTIAL SCATTERING: NONLOCAL POTENTIALS. Woloshyn, R. M. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Phys. Lett., B; 49: No. 5, 415-418(13 May 1974).

The soft-photon theorem states that, in the expansion of the bremsstrahlung amplitude in powers of the photon energy, the coefficients of the first two terms are determined by the physical (on-shell) elastic scattering amplitude, and its derivatives, and are independent of off-shell effects. This result has been shown in quantum field theory and in potential scattering for local potentials and for velocity-dependent potentials. In this letter the soft-photon theorem is proven for non-relativistic bremsstrahlung from a charged particle in an external, non-local potential. The interaction current matrix element is explicitly taken into account and it is found that, in the soft-photon limit, it cancels the re-scattering term and the off-shell effects in the external emission amplitude. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

25438 ATTENUATION OF 9.4-GHz ACOUSTICAL WAVES IN HELIUM FILMS. Frénois, C.; Joffrin, J.; Legros, P.; Levelut, A. (Laboratoire d'Ultrasons, Université Paris VI, 75230 Paris-Cédex 05, France). Phys. Rev. Lett. 32: No. 23, 1295-1298 (10 June 1974).

Using a standard acoustical technique, we present new data concerning the attenuation of 9.4-GHz phonons in thin helium films. The mechanical resonance of the film is observed in the temperature range 1.4 to 2.1 K. A comparison with the bulk case is made. (auth)

25439 OBSERVATION OF THE CRITICAL VELOCITY PEAK IN SUPERFLUID FILMS. Telschow, K.; Rudnick, I. (Department of Physics, University of California, Los Angeles, California 90024); Wang, T.G. Phys. Rev. Lett. 32: No. 23, 1292-1295 (10 June 1974).

Critical flow velocities measured by Doppler-shifted third sound in unsaturated helium II films are shown to exhibit a well-defined maximum as a function of film thickness and at this maximum to be considerably higher than those usually found in film flow. In addition, the critical velocity is strongly temperature dependent below the maximum and relatively temperature independent above. (auth)

25440 RENORMALIZATION-GROUP CALCULATIONS OF DIVERGENT TRANSPORT COEFFICIENTS AT CRITICAL POINTS. Halperin, B.I.; Hohenberg, P.C. (Bell Laboratories, Murray Hill, New Jersey 07974); Siggia, E.D. Phys. Rev. Lett. 32: No. 23, 1289-1292 (10 June 1974).

Recursion relations correct to lowest order in $\epsilon=4-d$ are obtained for simple models representing the critical dynamics of a binary liquid, a Heisenberg antiferromagnet, superfluid helium, and related systems. The exponents for the divergences of the transport coefficients satisfy the "scaling" relations predicted by mode-mode coupling theory. The viscosity of the binary liquid is predicted to diverge as $\kappa^{-4/19}$ near $d=4$, which is a new result. (auth)

25441 TRANSPORT COEFFICIENTS IN A TWO-DIMENSIONAL FERMI LIQUID. Fu, H.; Ebner, C. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev., A; 10: No. 1, 338-342(Jul 1974).

43210). Phys. Rev. A 10: No. 1, 338-342 (July 1974).

We calculate variationally the coefficients of thermal conductivity K_s, spin diffusion D_s, and transverse viscosity η_s in a two-dimensional Fermi liquid by using the Landau Fermi-liquid theory. The leading temperature dependence at small T is $K_s^{-1} \partial T \ln T$, $D_s^{-1} \partial T^2 \ln T$, and $\eta_s^{-1} \partial T^2$, in contrast with the behavior of a three-dimensional Fermi liquid, $K^{-1} \partial T$, $D^{-1} \partial T^2$, and $\eta^{-1} \partial T^2$. The resulting formulas are used to predict K_s, D_s, and η_s for the liquid ^{3}He monolayer or partial monolayer which can form on a free surface of superfluid ^{4}He. (auth)

25442 REEXAMINATION OF EVIDENCE FOR A BOSE-EINSTEIN CONDENSATE IN SUPERFLUID He^4. Jackson, H.W. (Scientific Research Staff, Ford Motor Company, Dearborn, Michigan 48121). Phys. Rev. A 10: No. 1, 278-294 (July 1974).

During the last five years, several different neutron scattering experiments have been carried out in search of direct evidence for Bose-Einstein condensation in superfluid He^4. Although the structure in the scattering line that was expected if a condensate were present has never been distinctly visible, various methods of analyzing the data have led to estimates for the condensate contribution that range between 2.4 and 17%. Reexamination begins with a review of this previous work. The next step is a calculation of the line shape using the impulse approximation (IA) and the momentum distribution function determined by McMillan by a Monte Carlo technique. The possibility of simple line broadening due to final-state interactions (FSI) is also considered. This initial treatment is essentially a repetition of one first carried out by Gersch and Smith, except that our work conforms to the conditions of the Mook, Scherm, and Wilkinson (MSW) experiment, which provides the most accurate data presently available for comparison purposes. Direct comparison suggests that the condensate fraction is no greater than about 4%, and that it may be vanishingly small. Observing that a more precise estimate would be possible if one could assess more accurately the FSI effects, particularly with respect to broadening, we then present evidence based on sum rules and other theoretical considerations which supports the idea that corrections to the IA may indeed be negligible under the conditions of the MSW experiment. With this as a basis, it is postulated that the IA is strictly applicable to the MSW data and the consequences are studied. First, it is found that the shape of the peak of the line observed by MSW would be consistent with no condensate at all; but if any were present, it would have to be less than 1%. A discussion of the conflict between this estimate and the (2.4 ± 1) % deduced by MSW is then given. Also a method of checking on the validity of the postulate concerning the applicability of the IA to the MSW conditions is described. Next, neglecting whatever condensate that is possibly present, the IA formula for $S(Q, \omega)$ and the experimental data of MSW is used to compute $n(k)$, the momentum distribution of atoms in liquid He^4. This, together with the kinetic energy per particle and the one-particle density matrix in the space-coordinate representation are reported for He^4 at 1.2 and 4.2 °K. (auth)

25443 NEW UNIVERSAL QUANTITY FOR THE He^4 SUPERFLUID TRANSITION. Ferer, M. (Department of Physics, West Virginia University, Morgantown, West Virginia 26506). Phys. Rev. Lett. 33: No. 1, 21-23 (1 July 1974).

Two-scale-factor universality is used to show that a simple combination of measurable critical amplitudes is universal. Good experimental agreement is observed. (auth)

25444 SUPERFLUIDITY OF THIN ^{4}He FILMS. Chan, M.H.W.; Yanof, A.W.; Reppy, J.D. (Laboratory of Atomic and Solid State Physics and Materials Science Center, Cornell University, Ithaca, New York 14850). Phys. Rev. Lett. 32: No. 24, 1347-1350 (17 June 1974).

Superfluid persistent currents have been studied in ^{4}He films adsorbed on a porous Vycor glass substrate at temperatures down to 150 mK. Stable superflow was observed in films as thin as 2.4 atomic layers at the lowest temperatures. Critical-velocity and superfluid-mass data were obtained as a function of film thickness. These data indicate that on a Vycor substrate superflow is only possible for films greater than 2 atomic layers in thickness and, further, that only the coverage above the first two layers contributes to the superflow. (auth)

25445 INELASTIC REFLECTION OF NEUTRONS AT THE SURFACE OF SUPERFLUID ^{4}He. Seiden, J. (Paris Univ., Orsay, France). Compt. Rend., Ser. B; 278: No. 14, 631-634 (1 Apr 1974). (In French).

The reflection of neutrons by surface excitations of superfluid ^{4}He was studied. For small k values of momentum transfers, the results obtained are identical to those corresponding to classical fluids. When k is large, differences occur between the reflection behavior of the two types of fluid. (FR)

Superconductivity

Refer also to abstract 25613.

25446 (FEI-358) SPIN DEPENDENCE OF DENSITY OF EXCITED STATES IN SUPERFLUID NUCLEAR MODEL. Ignatyuk, A. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1972. 25p. (In Russian). INIS.

The application of the mathematical treatment of the theory of superconductivity to the problem of density of activated states involves a number of special features due to the microcanonical nature of the ensemble considered. Variant sources should be formulated directly for the density of the state of the system. This procedure permits a correct description of the behavior of thermodynamic values at the point of phase transition and does not lead to a break in the density of state. The microcanonical nature of the activated nucleus is indicated also in the calculation of the spin dependence of the density of state. The moment of inertia, F_2, that determines this density differs from the moment of inertia F_1 usually used in calculations of dynamic moments. The effect of pair correlation on the properties of the highly activated nucleus is very apparent in the behavior of the parameter K_0^2, which determines the angular dispersion of fission fragments. This parameter has the same nature as the parameter of spin dependence, σ^2. Experimental data do not permit differentiating the energy dependence $F_2(\mu)$ from that of $F_1(\mu)$. The behavior of the density of the excited state with a high angular moment value must be known in examining the multicascade evaporation of particles, especially for reactions with heavy ions. The use for level densities of the ratios obtained at approximately small moments may lead to a significant distortion in the results. From the curves obtained in this work the level densities can be determined for all ranges of angular moments. (INIS)

25447 INFLUENCE OF MICROSTRUCTURE ON CRITICAL CURRENT DENSITY OF NIOBIUM-TITANIUM SUPERCONDUCTORS. Arndt, R.; Ebeling, R. (Krupp Friedr.) G.m.b.H., Essen (F. R. Germany). Forschungsinstitut). Z. Metallkd.; 65: No. 5, 364-373(May 1974). (In German).

From general meeting of the Deutsche Gesellschaft fuer Metallkunde, e. V.; Villach, Austria (12 Jun 1973). 17 figs.; 1 tab.; 20 refs.

Measurements of the critical current density J_c as a function of the applied magnetic field < = 7 T were made on copper coated niobium-titanium-, niobium-titanium-copper- and niobium-titanium-germanium-wires heat treated at temperatures between 300 and 500°C. The microstructure of the samples was investigated by transmission electron microscopy and electron diffraction. Copper additions to the niobium-titanium alloy cause an increase in J_c in large magnetic fields if the samples are annealed several times. Heat treatment of germanium containing niobium-titanium alloys, however, results in markedly lower J_c-values. Microstructure investigations show that sub-band-diameters of 300 to 500 A are a necessary but not a sufficient condition for large J_c-values. A pronounced increase in J_c is caused by precipitates with a diameter smaller than 500 A which cause the drawing texture and the sub-band-structure to be less pronounced. Copper additions cause precipitation of rounded particles. These make texture and sub-band-structure less pronounced than in niobium-titanium-wires with elongated precipitates. Precipitation is hindered in germanium containing alloys and thus a strong drawing texture and sub-band-structure are maintained during heat treatment. Low critical current densities are the result. The investigations of the precipitation processes are compared with literature data. According to the findings of the electron microscopy investigations the samples are grouped into three categories. For all three categories the J_{cH}-measurements are presented in the form of reduced Lorentz-force-curves which are the basis for the concluding discussion. (auth)

25448 ON THE PRODUCTION OF SUPERCONDUCTING ALLOYS BASED ON COPPER. Mordike, B. L. (Liverpool Univ. (UK). Dept. of Metallurgy and Materials Science). Z. Metallkd.; 65: No. 5, 395-396(May 1974).

9 refs.

The production of copper base copper-niobium superconducting wire by powder metallurgical techniques is discussed. By ensuring a uniform fine distribution of niobium superconductivity is observed in alloys >95% Cu. Such alloys are inherently ductile and can be processed by conventional methods. (auth)

25449 SYNTHESIS OF SUPERCONDUCTING COMPOUNDS BY THERMOLYSIS OF VOLATILE HYDRIDES AND ORGANOMETALLIC COMPOUNDS ON GLOWING WIRES. Schrauzer, G. N.; Prakash, H. (Univ. of California, La Jolla). Solid State Commun.; 14: No. 11, 1259-1262(1 Jun 1974).

The synthesis of high temperature superconducting phases in the Nb–Ge, Nb–Sn, V–Si, V–Ge, V–Sn, Nb–C and Mo–C systems is described by a method consisting in the thermolysis of volatile hydrides or organometallic compounds on resistively heated wires. For face-centered cubic NbC a higher transition temperature than previously reported was obtained. The A15 phase boundary of Nb–Ge is extended towards the stoichiometric 3 : 1 composition, affording samples of Nb_3Ge with a T_c onset of 15.8°K. (auth)

25450 ABSORPTION OF ULTRASOUND IN SUPERCONDUCTORS WITH OVERLAPPING ENERGY BANDS. Druinskii, E.I. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Solid State 15: No. 12, 2493-2494 (June 1974).

The frequency and temperature dependences of the absorption coefficient of ultrasound are derived for pure two–band superconductors. (AIP).

25451 SUPERCONDUCTIVITY IN NEW A-15 COMPOUNDS OF NIOBIUM. Johnson, G. R. Rochester, NY; University of Rochester (1974). 124p. University Microfilms Order No. 74-14,399.

Thesis (Ph. D.).

Superconductivity in a range of alloys related to Nb_3Al, Nb_3Ga, Nb_3Ge, and Nb_3Si was surveyed using samples prepared by simultaneous sputtering from two alloy cathodes. X-ray diffraction patterns for suitably annealed samples indicate A-15 structures for the compounds above as well as for their pseudo-binary alloys. Transition temperatures measured resistively were in the range 13 to 16°K, except near pure Nb_3Si which had a T_c of 6.9°K. Maxima of T_c were found at the compositions $Nb_3Al_{.7}Ge_{.3}$ and $Nb_3Ga_{.5}Al_{.5}$. The first is well known; trends measured in this study indicate the second may have an equally high T_c near 21°K in properly prepared bulk samples. Explorations of hypothetical A-15 Nb_3P failed to confirm its existence; however, its pseudo-binary A-15 derivative $Nb_3P_xGe_{1-x}$ was identified. A critical survey of reported A-15 compounds is presented along with an expanded set of Geller A-15 radii. This survey documents the close relationship between the A-15 and tetragonal (Ti_3P and Ni_3P type) structures. Trends in the Geller radii for the above group of alloys suggest that there is little change in the number of bonding electrons among compounds of the group studied in spite of changes in the e/a number. The high and relatively constant T_c for this group is explained by the Fermi level lying near a high peak in the electronic density of states with variations in e/a accommodated by a non-rigid band. Micro-strain disorder, an observed feature of these samples, can account for their critical temperatures being reduced from reported bulk values. There seems to be little effective variation in electronic structure of the group of alloys related to Nb_3Sn, Nb_3Al, Nb_3Ga, and Nb_3Ge; this suggests that trends in T_c observed in this study, as well as by others, may be largely due to varying degrees of disorder. (Diss. Abstr. Int., B)

25452 METHOD OF MAKING A SOLID-STATE SUPERCONDUCTING ELECTROMAGNETIC RADIATION DETECTOR. Strongin, M.; Saxena, A. M.; Crow, J. E. (to United States Atomic Energy Commission). US Patent 3,824,457. 16 Jul 1974. Filed Date 4 Apr 1973. 8p.

Method for making a solid-state superconducting electromagnetic radiation detector by the steps of dividing aluminum into tangled, irregular, clusters of small randomly arranged oxide coated aluminum particles that are compressed and shaped into a self-sustaining solid mass is described. Connecting leads to the mass and cooling the mass to superconducting temperatures provides a transducer-detector that produces an output voltage in response to electromagnetic radiation that is incident on the surface of the mass over a broad band of frequencies. (auth)

25453 EFFECT OF LOCALIZED SPIN FLUCTUATIONS ON SUPERCONDUCTING PROPERTIES OF DILUTE ALLOYS. Rössler, J.; Kiwi, M. (Facultad de Ciencias, Universidad de Chile, Casilla 653, Santiago, Chile). Phys. Rev. B 10: No. 1, 95-104 (1 July 1974).

The effects of localized spin fluctuations on the critical temperature T_c and the specific-heat jump $\Delta C(T_c)$ of dilute superconducting alloys is investigated, both in the weak and strong magnetic limits. In the weak magnetic limit (rapid spin fluctuations) we find that the expression of Kaiser for $T_c(n_i)$, where n_i is the impurity concentration, which was derived for resonance scattering, still holds with redefined values of the pertinent parameters, while the specific-heat jump obeys a BCS law of corresponding states. In the slow-spin-fluctuation limit the result of Abrikosov and Gor'kov (AG) for $T_c(n_i)$ is recovered, with a redefined expression for the Cooper-pair lifetime, while $\Delta C(T_c)$ as function of reduced temperature is depressed below the AG value. (auth)

25454 COMMENTS ON "ANOMALOUS ULTRASONIC ATTENUATION IN PURE SUPERCONDUCTING Nb". Nusair, M.; Tang, I. (Department of Physics, American University of Beirut, Beirut, Lebanon). Phys. Rev. B 10: No. 1, 308-312 (1 July 1974).

The recently reported measurements of the ultrasonic attenuation of both longitudinal and transverse waves in a pure niobium superconductor by Carsey and Levy are analyzed on the basis of a two-band description of the superconducting state. It is seen that some of the ambiguities resulting from a single-band analysis are not present in the two-band analysis. (auth)

25455 UPPER CRITICAL FIELD AND CRITICAL TEMPERATURE FOR SUPERCONDUCTING ALLOYS DESCRIBED BY THE ANDERSON MODEL. Arnold, G.B. (Physics Department, University of California, Los Angeles, California 90024). Phys. Rev. B 10: No. 1, 105-119 (1 July 1974).

Extending some recent work by Shiba, we have used the Hartree–Fock approximation for the Anderson model of localized-impurity-electron states in a superconductor to obtain expressions for the critical temperature in zero magnetic field and for the upper critical field. The expression for the critical temperature reduces to Kaiser's result in the limit of no impurity magnetic moment, and Fulde and Maki's result in the magnetic limit. Between these two limits results are found which differ appreciably from those of either limit. (auth)

25456 PHASE TRANSITIONS AND SUPERCONDUCTIVITY OF Bi–In ALLOYS AT HIGH PRESSURES. Laukhin, V.N.; Matyushchenkov, V.K.; Rabin'kin, A.G. (Uzhgorod State University). Sov. Phys.–Solid State 16: No. 1, 183-184 (July 1974).

Phase X of the Bi–In system is studied with particular emphasis on its superconducting properties. (AIP)

25457 SCATTERING OF THERMAL PHONONS BY DISLOCATIONS IN SUPERCONDUCTING LEAD AND TANTALUM. O'Hara, S.G.; Anderson, A.C. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Rev. B 10: No. 2, 574-579 (15 July 1974).

Thermal-conductivity measurements on deformed superconducting samples of Pb and Ta have demonstrated the resonant scattering of thermal phonons from dislocations. The results are in good agreement with calculations based on the elastic-string model of localized modes associated with dislocations. (auth)

25458 MOMENTUM DISTRIBUTION IN THE TOMONAGA MODEL AT FINITE TEMPERATURES. Aizenman, M.; Gutfreund,

H. (Hebrew Univ. of Jerusalem). J. Math. Phys. (N.Y.); 15: No. 5, 643-647(May 1974).

The momentum distribution function of the one-dimensional Tomonaga model is evaluated, and its properties are discussed. The effect of finite temperatures on the applicability of the model is investigated. (auth)

25459 ATOMIC ORDERING AND SUPERCONDUCTIVITY IN HIGH-T_c A-15 COMPOUNDS. Sweedler, A.R.; Schweitzer, D.G. (Brookhaven National Laboratory, Upton, New York 11973); Webb, G.W. Phys. Rev. Lett. 33: No. 3, 168-172 (15 July 1974).

Large, reversible changes in the superconducting transition temperature T_c of the Nb-based A-15 compounds Nb_3Al, Nb_3Sn, Nb_3Ga, $Nb_3(Al,Ge)$, and Nb_3Ge are observed when irradiated with high-energy ($E > 1$ MeV) neutrons at 60°C. The transition widths of the irradiated samples are of the same order as the unirradiated samples and the original T_c's are recovered by annealing. The results are discussed in terms of atomic ordering in the A-15 structure. (auth)

25460 ORDER-PARAMETER FLUCTUATIONS IN SMALL SUPERCONDUCTING PARTICLES. Mühlschlegel, B. (Institut für Theoretische Physik, Universität zu Köln, Köln, Germany). Phys. Rev. B 10: No. 3, 1127-1128 (1 Aug 1974).

The generalized Ginzburg-Landau approximation for small metal particles is reconsidered with respect to its applicability to the specific heat and the diamagnetic susceptibility. (auth)

25461 TOMASCH-OSCILLATION AMPLITUDE DECAY IN SINGLE-CRYSTAL LEAD FILMS. Haywood, T.W.; Mitchell, E.N. (Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27514). Phys. Rev. B 10: No. 3, 876-881 (1 Aug 1974).

The dependence of the amplitude of Tomasch oscillations on energy is measured for several different orientations of single-crystal lead films. Anisotropy in this amplitude is observed. Comparison is made between experiment and the predictions of several theories. In general the observed decay in amplitude with energy is more rapid than theoretical predictions. The best fit occurs with the McMillan-Anderson model and the Wolfram model with proximity effects. (auth)

25462 SUPERCONDUCTIVITY IN METASTABLE SIMPLE CUBIC ALLOYS. Johnson, W.L.; Poon, S.J. (W. M. Keck Laboratory of Engineering Materials, California Institute of Technology, Pasadena, California 91109). J. Appl. Phys. 45: No. 8, 3683-3684 (Aug 1974).

Results of resistivity measurements and x-ray studies of four additional superconducting metastable simple cubic alloys are presented. It is found that, in general, superconducting phases with simple cubic structure occur at average valence electron concentrations of 4.5 and 6.5 valence electrons per atom, and average valence electron densities of 0.16 and 0.26 electrons/Å^3. An inverse relation between the transition temperature T_c and the lattice spacing is pointed out which applies generally for both antimony- and tellurium-base alloys. (auth)

25463 EFFECT OF A SEMICONDUCTING INTERFACE ON THE TRANSITION TEMPERATURE OF A SUPERCONDUCTOR: THE IMAGE TERM. Rangarajan, S. (Tata Institute of Fundamental Research, Bombay-400005, India). Phys. Rev. B 10: No. 3, 872-875 (1 Aug 1974).

The problem of superconductivity near a metal-semiconductor interface has been studied, using the dielectric formulation of the problem. Assuming a sharp boundary, the bulk regions of the two media are described by simple model dielectric functions, and the effective electron-electron interaction in the metallic region near the interface is obtained within the framework of classical electrostatics. The strength of the effective coupling constant for the classical image term relevant to superconductivity depends strongly on q_sL, where q_s is the static screening wave vector of the metal and L is its thickness. It is appreciable only for very small q_sL ($\lesssim 10$). However, this is always smaller in magnitude than the repulsive Coulomb coupling constant, so that by itself it cannot lead to superconductivity. Nevertheless, it can appreciably alter the superconducting transition temperature T_c of a metal, which becomes superconducting due to some other mechanism. This has been calculated as a function of q_sL, $q_s/2k_F$, and ϵ_0, where k_F is the Fermi wave vector of the metal and ϵ_0 is the static dielectric constant of the semiconductor. (auth)

25464 SCALING LAWS FOR FLUX PINNING IN Nb AND NbTi MULTIFILAMENTARY CONDUCTORS. Mathur, M.P.; Ashkin, M.; Deis, D.W. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). J. Appl. Phys. 45: No. 8, 3627-3633 (Aug 1974).

Magnetization measurements M(H,T) are made on several commercially drawn Nb-Cu and NbTi-Cu multifilamentary conductors as a function of applied magnetic field and temperature. The samples are distinguished by their filament sizes or the amount of cold work. From these measurements the pinning force $F_p(H,T)$ and the critical current characteristics $J_c(H)$ are deduced for all samples. Using this information Kramer's scaling laws for flux pinning in multifilamentary conductors were tested. It is found that the model with some reservations seems to account for most of the observed behavior in the Nb-Cu and NbTi-Cu systems. (auth)

25465 CURRENT-INDUCED MAGNETIC-FLUX STRUCTURES IN A TYPE-I SUPERCONDUCTING CONSTRICTION. Watson, H.L.; Kampwirth, R.T.; Huebener, R.P. (Argonne National Laboratory, Argonne, Illinois 60439). J. Appl. Phys. 45: No. 8, 3634-3637 (Aug 1974).

We have studied the current-induced magnetic-flux structures in type-I superconducting constrictions using a high-resolution magneto-optical method. The samples were Pb films 60-100 μm thick with a single constriction of 0.5-1.0 mm width, similar to the Anderson-Dayem bridge geometry. In the resistive state, moving flux-tube trains are nucleated at both sample edges, at first precisely at the narrowest portion of the constriction. With increasing current, the flux-tube trains extend more and more into the outlying regions performing a curved path. From the resistive voltage and our magneto-optical observations the flux-tube nucleation rate for a flux-tube train is estimated using the Josephson relation. (auth)

25466 SPIN FLUCTUATION DEPRESSED SUPERCONDUCTIVITY IN Nb-V ALLOYS. Rapp, O.; Crafoord, C. (Royal Inst. of Tech., Stockholm). Phys. Status Solidi (b); 64: No. 1, 139-149 (1 Jul 1974).

The electrical resistivity of Nb-V alloys was measured around 250°C. Together with published values of the susceptibility and the electronic part of the specific heat, the contribution of spin fluctuations to the depression of the superconducting transition temperature, T_c, was estimated. A calculation of T_c based on experimental resistivity, susceptibility, and specific heat and with one adjustable parameter shows qualitative agreement with the observed T_c over the whole alloy system and reasonable quantitative agreement in the dilute NbV region. Further evidence for the existence of spin fluctuations in Nb-V and an enhanced electron-phonon coupling constant λ in V is derived from the observed rate of depression of T_c with V concentration, published band structure calculations for V, and published Knight shift relaxation times. (44 references) (auth)

25467 FLUX LINE LATTICE IN ANISOTROPIC TYPE-II SUPERCONDUCTORS. Dobrosavljevic, L. (CNRS, Grenoble, France); Raffy, H. Phys. Status Solidi (b); 64: No. 1, 229-236 (1 Jul 1974).

Anisotropy effects on the flux line lattice in type-II superconductors are investigated by means of an effective mass theory approach. Both a deformation and an orientation effect are found. (auth)

25468 SOLUTION OF GORKOV'S THEORY FOR TYPE-II SUPERCONDUCTORS BY MEANS OF THE CORRELATION FUNCTION OF THE GAP. Brandt, E. H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi (b); 64: No. 1, 257-268(1 Jul 1974).

The nonlocal theory for type-II superconductors given in a previous paper is shown to be valid even at zero temperature, where Gorkov's theory cannot be linearized. The periodic solutions for the gap, Δ, and the magnetic field, H, may be calculated from this theory by introducing the correlation function of Δ and H. The properties of the correlation function are discussed in detail. An explicit form of the nonlocal functional is given which has to be minimized with respect to a few Fourier coefficients of $|\Delta|^2$ and H. In this way, the magnetization curve and the field distribution H is obtained. (auth)

25469 STRUKTURA I SVOISTVA SVERKHPROVODYASHCHIKH MATERIALOV. (Structure and Properties of Superconducting Materials). Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). 183p.

The results of studies of the structure and properties of superconducting materials as a function of fabrication process, alloying, and thermal processing were reported in this collection of 27 papers. The effect on the superconducting characteristics of extreme processing conditions for the alloys, such as quenching rate and the use of high pressure, were also examined. The mechanical properties of the alloys at low temperatures were studied. Some aspects of the use of superconducting materials were shown. Separate abstracts were prepared for the individual papers. (tr-auth)

For abstracts of individual papers see: 25470-25496.

25470 EFFECT OF PRESSURE ON THE SUPERCONDUCTING TRANSITION OF $Nb_{12}Al_3Ge$. Ageev, N. V.; Alekseevskii, N. E.; Shamrai, V. F. pp 3-6 of Struktura I Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of mechanical influences on the superconducting transition and the structure of cast samples of $Nb_{12}Al_3Ge$ was

studied. Grinding, uniaxial compression at a weight of 20 t/cm^2, and high pressures (60 and 100 kbar) led to a blurring of the transition curve and its displacement to a low temperature region. Simultaneously size reduction of the mosaic block occurred and stresses of the second type arose. (tr-auth)

25471 METHODS FOR THE PREPARATION OF FLEXIBLE SUPERCONDUCTORS BASED ON THE SUPERCONDUCTING COMPOUNDS OF THE A15 TYPE. Savitskii, E. M.; Efimov, Yu. F.; Zvolinskii, O. I. pp 7-14 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

A comparative analysis was made of the methods for the fabrication of superconducting materials based on type A15 compounds. These compounds include Nb_3Sn, V_3Si, V_3Ga, Nb_3Al, Nb_3Ga, and $Nb_3Al_{0.8}Ge_{0.2}$. The superconducting characteristics of these type compounds were also analyzed. The method of diffusion into the solid state appears the most promising and technologically feasible. This method makes it possible to obtain wires that are ductile after heat processing. It is advisable to eliminate preliminary coating of the V rod with Ga with the introduction of the A components of A15 compounds into the laminated coating and the B components into the interior. (tr-auth)

25472 EFFECT OF QUENCHING FROM THE LIQUID STATE ON THE SUPERCONDUCTING PROPERTIES AND STRUCTURE OF Nb–Ga ALLOYS AND Nb_3(Ge,Al). Bychkov, Yu. F.; Kruglov, V. S.; Sizov, B. T.; Yakovlev, E. I. pp 14-19 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

T_c of alloys of the Nb–Ga and Nb_3Ge–Nb_3Al systems, quenched from the liquid state at rates up to $10^{6°}$/sec, was measured. Quenching from the liquid state made it possible to increase the Ga content in Nb_3Ga in comparison with the equilibrium diagrams and to increase T_c for the beginning of the transition up to 18°K. Extensive blurring of the transition curve was observed during this. In the pseudobinary system Nb_3Ge–Nb_3Al a T_c peak was observed for the alloy $Nb_3(Ge_{0.25}Al_{0.75})$. Thermal processing of the quenched alloy increased T_c 1 to 3°K and for Nb_3Ga the maximum T_c for the initiation of the transition increased 19°K. (tr-auth)

25473 SUPERCONDUCTING PROPERTIES OF THE Nb_3(Ga, Ge, Al) SYSTEMS. Kruglov, V. S.; Bychkov, Yu. F.; Tsuprun, V. L.; Cherkasov, N. A. pp 19-24 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of composition on the T_c of alloys of the Nb_3(Ge, Ga, Al) systems was studied. Cast alloys based on Nb_3Al (up to 30 mol. % Nb_3Ga and Nb_3Ge) had the highest value of T_c, slightly dependent on the composition. Thermal processing increased the T_c of some alloys 1.75°K. A decrease of the T_c of Nb_3Ga with addition of transition metals of the IV and V groups was observed. The decrease was dependent on the mass of the atom of the addition. Regularities in the variation of T_c were explained on the basis of work by Martin and McMillan. (tr-auth)

25474 STUDY OF MUTUAL DIFFUSION IN THE Nb–Ge–Al SYSTEM. Ronami, G. N.; Berezina, V. P. pp 25-29 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The possibility of obtaining superconducting alloys of the Nb–Ge–Al system with high T_c by the method of diffusing layers and its study by the method of x-ray microanalysis was shown. The quantity, composition, and homogeneity of the phases formed were determined on diffusion layers annealed at 1600 and 1700°C. T_c was measured. (tr-auth)

25475 NUCLEAR GAMMA RESONANCE IN COMPOUNDS OF THE Nb–Sn SYSTEM. Gruzin, P. L.; Bychkov, Yu. F.; Evstyukhina, I. A.; Kruglov, V. S.; Alekseev, L. A. pp 29-35 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The superconducting properties and nuclear magnetic resonance characteristics of phases of the Nb–Sn system were studied. The NMR spectra of the Nb solid solution and Nb_3Sn were represented by a single line but in the spectra of Nb_6Sn_5 and $NbSn_2$ quadrupole splitting (Δ Nb_6Sn_5 = 1.7 mm/sec and Δ $NbSn_2$ = 2.12 mm/sec) was observed. This was caused by the presence of large gradients of the electric field in the Sn nucleus in these compounds. The 5S electron densities, determined from the NMR spectra in the Sn nucleus, were 0.97, 1, and 1.05, respectively, for Nb_3Sn, Nb_6Sn_5, and $NbSn_2$. (tr-auth)

25476 INVESTIGATION OF THE EFFECT OF IMPURITIES OF THE TRANSITION ELEMENTS Mo AND W ON THE FORMATION KINETICS AND SOME SUPERCONDUCTING PARAMETERS OF THE INTERMETALLIC COMPOUND Nb_3Sn. Ronami, G. N.; Berezina, V. P.; Baranov, I. A.; Konovalov, N. T.; Andreev, M. V.; Zhrutova, T. V. pp 35-45 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of small additions of Mo and W on the T_c of Nb and Nb_3Sn was studied. The composition, homogeneity range, and quantity of the phase formed was studied by x-spectral analysis on diffusion layers annealed at 1350, 1500, and 1800°C. Impurities of Mo and W decrease the T_c of Nb and Nb_3Sn. (tr-auth)

25477 STUDY OF THE EFFECT OF IMPURITIES OF THE TRANSITION ELEMENTS Ti AND Zr ON THE KINETICS OF FORMATION AND SOME SUPERCONDUCTING PARAMETERS OF THE INTERMETALLIC COMPOUND Nb_3Sn. Ronami, G. N.; Berezina, V. P.; Baranov, I. A.; Konovalov, N. T.; Andreev, M. V.; Zhrutova, T. V. pp 45-57 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of Ti and Zr impurities on the T_c of Nb and Nb_3Sn was studied on diffusion layers annealed at 1350, 1500, and 1800°C by local x-ray spectral analysis and other methods of physicochemical study. The kinetics for the formation of Nb_3Sn, the width of the region of the phase of homogeneity, and the increase of the T_c of Nb and Nb_3Sn in some concentration intervals of the impurities were established. (tr-auth)

25478 EFFECT OF SAMARIUM ON THE SUPERCONDUCTING PROPERTIES OF THE COMPOUNDS Nb_3Sn AND Nb_3Al. Savitskii, E. M.; Baron, V. V.; Bychkova, M. I.; Sumarokov, V. N. pp 57-62 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of Sm on the structure and the superconducting transition temperature of the compounds Nb_3Sn and Nb_3Al was studied. Alloys were studied in the cast and thermally processed state. The solubility of Sm in Nb_3Sn and Nb_3Al is completely insignificant. The T_c of these compounds is not decreased. (tr-auth)

25479 STUDY OF DIFFUSION LAYERS IN THE NIOBIUM–TIN AND NIOBIUM–TIN–COPPER SYSTEMS. Bondarenko, E. A.; Morozov, I. V.; Pakhomov, V. Ya.; Petukhova, A. S.; Posyado, V. P.; Sokolov, V. L.; Speranskaya, N. L.; Revyakina, L. P. pp 63-68 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

By means of x-ray analysis and electron microscopy the phase composition and structure of the layers obtained on strips of Nb after metallization in Sn and Sn–Cu baths at 900°C and after subsequent annealing at 920 and 950°C for one hr was studied. It was shown that the strips metallized in the Sn bath and annealed at 920°C are biphase (Nb_6Sn_5 and Nb_3Sn). At 950°C the layer is one-phased (Nb_3Sn). The introduction of Cu leads to the formation of the one-phase layer Nb_3Sn and reduction of its grain size. Correlations were observed between the grain dimensions of the Nb_3Sn layer and the value of the critical current. (tr-auth)

25480 STRUCTURE AND SUPERCONDUCTING PROPERTIES OF V_3Ga-BASED ALLOYS. Vorob'eva, N. S.; Sokolov, V. I.; Kuznetsova, S. M.; Zhdanov, G. S.; Lyamina, M. P. pp 68-71 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The change of the lattice constants, T_c, and density of V_3Ga-based alloys was studied as the function of the change of the structure of the V_3Ga phase. The mechanisms of the concentration disordering of the V_3Ga phase (substitution and subtraction) and the effect of the disordering on its superconducting properties were examined. (tr-auth)

25481 EFFECT OF ALLOYING THE VANADIUM BACKING ON THE STRUCTURE AND SUPERCONDUCTING PROPERTIES OF THE COMPOUND V_3Ga. Vorob'eva, N. S.; Sokolov, V. I.; Pakhomov, V. Ya.; Bondarenko, E. A.; Shneider, M. D. pp 72-77 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of alloying the V backing on the structure of the compound V_3Ga, obtained by the diffusion method, was studied. The quantity of alloying components (Ti, Zr, Hf, Nb, and Ta) did not exceed the limits of their solubility in V. The alloying of the V backing with Ta and particularly Zr led to a reduction of the grain size of the V_3Ga phase. The critical current density in a

field of 50 kOe increased during alloying with Ti, Nb, and Ta. (tr-auth)

25482 STRUCTURE AND SUPERCONDUCTING PROPERTIES OF TERNARY ALLOYS BASED ON METALLIC COMPOUNDS. Savitskii, E. M.; Baron, V. V.; Efimov, Yu. V.; Bychkova, M. I.; Myzenkova, L. F.; Sumarokov, V. N. pp 77-84 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The structure and superconducting properties of ternary alloys based on some Nb and V compounds with A15-type structure were studied. The compounds studied were Nb_3Sn, Nb_3Ga, Nb_3Ge, V_3Si, and V_3Ga. Regularities in the change of the superconducting transition temperature were established. (tr-auth)

25483 FORMATION OF A SUPERCONDUCTING PHASE DURING HIGH PRESSURE AND HIGH TEMPERATURE PROCESSING OF β-La_2S_3. Vereshchagin, L. F.; Evdokimova, V. V.; Novokshonov, V. I.; Eliseev, A. A.; Grizik, A. A.; Bespyatkin, V. V.; Sorokina, N. I.; Semenova, E. E. pp 84-93 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

During processing of the dielectric La_2S_3 in a pressure chamber of the Bridzhmen type (30 to 100 kbar) and temperatures up to 1800°C, five metastable superconducting phases were obtained on quenching with T_c equal to 5.9 to 6.6, 7.2 to 7.6, 8.3 to 8.6, 10.4 to 10.7, and 14.1 to 14.5. Assumptions were made on the nature of these phases. (tr-auth)

25484 SUPERCONDUCTING SOLENOID AT 104 kOe FROM NIOBIUM STANNIDE. Bashlov, V. A.; Kunakov, Ya. N.; Bulynin, V. L.; Mel'nikov, V. I.; Gripas, Yu. N.; Gerasimov, L. N.; Belov, A. V. pp 93-95 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The results of tests of the one-section solenoid with magnetic field intensity of 104 kOe (at 4.2°K), prepared from superconducting strips of Nb_3Sn stabilized with Cu, were reported. The use of a ferromagnetic concentrator makes it possible to increase H_c up to 124 kOe. (tr-auth)

25485 CALCULATION OF THE SUPERCONDUCTING TRANSITION TEMPERATURE FOR THE NIOBIUM-TITANIUM SYSTEM. Savitskii, E. M.; Baron, V. V.; Bychkova, M. I. pp 96-99 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

On the basis of available calculation methods proposed by Hopfild and McMillan, the values of T_c and the interaction parameter λ for alloys of the Nb-Ti system were obtained in the solid solution region. The T_c values obtained changed as a function of the composition of the alloy, similar to results obtained experimentally. (tr-auth)

25486 EFFECT OF DEFORMATION ON THE TEMPERATURE OF TRANSITION TO THE SUPERCONDUCTING STATE ON NIOBIUM AND VANADIUM SINGLE CRYSTALS. Savitskii, E. M.; Baron, V. V.; Myzenkova, L. F.; Sumarokov, V. N. pp 100-105 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of deformation on T_c and the transition width ΔT_c was studied on Nb and V single crystals obtained by the method of electron-beam zone melting. Deformation up to 80% decreases T_c, but increases ΔT_c. (tr-auth)

25487 EFFECT OF n-s TRANSITION ON THE INTERNAL FRICTION OF VANADIUM. Postnikov, V. S.; Miloshenko, V. E.; Shunin, G. E.; Shukhalov, E. I. pp 105-108 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The internal friction of V during the transition from the superconducting to the normal state in an external magnetic field was studied at a fixed temperature. In the n-s transition region a maximum for the internal friction was observed. It is connected with dissipative processes caused by the fluctuation of the order parameters. (tr-auth)

25488 STUDY OF THE POSSIBILITY OF OBTAINING TWO-COMPONENT FILMS OF VARIABLE COMPOSITION AND THE STUDY OF THEIR SUPERCONDUCTING PROPERTIES. Savitskii, E. M.; Efimov, Yu. V.; Sumarokov, V. N.; Pozin, A. I. pp 108-116 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The dependence of T_c on the alloy composition was studied on vacuum-deposited films of variable composition with a thickness of 4000 to 10,000 Å. The type of phase diagram was established for the Nb-Sm, V-Sm, Zr-Sm, Tl-Sm, Pb-Sm, and Pb-La systems. The dissolution of Sm in Nb and V (<0.1 at. % during saturation) led to a reduction of T_c to 9 and 4.7°K respectively. In the Pb-La system only solid solutions based on Pb (<0.15 at. % La) and La (<0.1 at. % Pb) possessed superconductivity. T_c of these solutions was 6.5 and 4.9°K respectively. The T_c of Pb was decreased with dissolution of Sm (<0.14 at. %) to 7°K. In the region from 25 to 52.4 at. % Sm a new compound with T_c = 6.7°K was detected. Compounds of Pb with Sm and alloys of Sm with Ti and Zr were superconducting at temperatures above 4.2°K. (tr-auth)

25489 DEPENDENCE OF THE FORM OF THE $j_c(H)$ CURVE ON THE STRUCTURAL STATE OF THE ALLOYS 35BT, 50BT, AND 65BT. Kadykova, G. N.; Prokoshin, A. F.; Fedotov, L. N. pp 116-122 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Two alloys of the 35BT type (one containing 30% Nb and 7.5% Zr and the other 35% Nb, 7.5% Zr, and 0.66% Fe), two alloys of the 50BT type (one containing 50% Nb and 7.5% Zr and the other 50% Nb, 7.5% Zr, and 0.55% Fe), and one alloy of the 65BT type (65% Nb and 7.5% Zr) were studied. The relation of the forms of the $j_c(H)$ curves and the j_c levels of these alloys after cold deformation and low-temperature annealing with their structure was shown. Curves with a plateau were obtained after processing leading to the formation of structures with a high density of pinning centers. In alloys of the 65BT type the level with the current-carrying properties was defined by a dislocation structure. (tr-auth)

25490 CRITICAL CURRENTS OF THE Ti-Nb-Ta-O ALLOYS. Bychkov, Yu. F.; Uzlov, V. Yu.; Rozanov, A. N.; Mitrofanskii, A. A. pp 123-130 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of replacing part of the Nb with Ta in alloys with 40 and 50 wt % Ti and the effect of structural changes during annealing on j_c were studied in alloys of the Ti-Nb-Ta system in the region of concentrations corresponding to a high H_c. The introduction of oxygen to the alloys and the creation of an optimum structural state led to an increase of j_c. (tr-auth)

25491 EFFECT OF PROCESSING ON THE PROPERTIES OF WIRES OF THE SUPERCONDUCTING ALLOY 60T. Galkin, A. A.; Baikov, A. I.; Buryak, V. P.; Golovlev, Yu. N.; Korneeva, G. A.; Malyshev, E. N. pp 130-138 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of hydroextrusion on the structure and mechanical and superconducting properties of wires of the 60T alloy (Nb-60 at. % Ti) was studied. The density, ductility, and critical current density of the wires obtained by hydroextrusion were higher than in wires obtained by the usual technology. (tr-auth)

25492 ELECTRICAL PROPERTIES UNDER PRESSURE OF THE SUPERCONDUCTING ALLOYS OF Ti-Nb-Zr WITH ADMIXTURES OF IRON AND GADOLINIUM. Kirshenina, I. I.; Fedotov, L. N. pp 139-145 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of small additions of ferromagnetic metals on the character of the change of the electric resistance under pressure, the structure, and superconducting properties of 35BT-type alloys was studied. (tr-auth)

25493 EFFECT OF THE QUENCHING RATE AND NITROGEN CONTENT ON THE STRUCTURE AND SUPERCONDUCTING PROPERTIES OF VANADIUM, NIOBIUM, AND SOME OF THEIR ALLOYS. Savitskii, E. E.; Revyakin, A. V.; Efimov, Yu. V.; Glyuzitskii, B. D.; Sumarokov, V. N. pp 145-156 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of the cooling rate (up to 10^7°/sec) and the nitrogen content (up to 1.5 wt %) on the properties of V, Nb, and their alloys with Ti was studied. Rapid quenching from the liquid state fixes the one-phase solid solution with a significant nitrogen content, causes reduction of the grain size of the solid solution, nitride particles, and the omega phase, increases the critical current density, dislocation density, stability, and hardness with simultaneous increase of the ductile properties, and neutralizes the detrimental effect of nitrogen on the T_c of the materials studied. (tr-auth)

25494 REGULARITIES IN THE CHANGES OF THE MECHANICAL PROPERTIES OF TITANIUM AT TEMPERATURES FROM 4.2 TO 1173°K. Mikheev, V. S. pp 156-165 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The regularities of the changes in the mechanical properties and electrical resistance of commercial Ti were examined at 4.2 to 1173°K. The deformation of Ti was carried out at low temperatures. Anomalies were observed in the changes of the mechanical properties of Ti at cryogenic temperatures: at 20°K and below the strength of Ti is decreased and the ductility is increased. (tr-auth)

25495 DETERMINATION OF THE OPTIMUM CONDITIONS FOR THE PRESSURE PROCESSING OF NIOBIUM SUPERCONDUCTING ALLOYS. Arsen'ev, O. B.; Okhrimenko, Ya. M. pp 165-171 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The mechanical properties of Nb-Zr-Ti alloys at different temperatures were studied. The recrystallization diagram for the processing was constructed. The construction of a backed cutting open die with adapter cone making it possible to deform cylindrical hard-to-deform alloys by hammer with a constant degree of deformation of $\epsilon = 0.25$ with a relative feed rate of 0.7 to 1.0 was described. A temperature regime for the processing was proposed. (tr-auth)

25496 CONSTRUCTION AND TECHNOLOGICAL CHARACTERISTICS OF NIOBIUM WIRES FOR SUPERCONDUCTING COAXIAL RADIO-FREQUENCY CABLES. Khrenkov, N. N.; Gal'perovich, D. Ya. pp 171-176 of Struktura i Svoistva Sverkhprovodyashchikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of the process for the fabrication of wires on the surface properties at superhigh frequencies was studied. The indicators, suitable for evaluation of the high-frequency superconducting properties of the wires in the fabrication process, were established. Methods for the measurement of the surface resistance and surface contamination were proposed. (tr-auth)

25497 INTERDEPENDENCE OF SUPERCONDUCTIVITY, ELECTRONIC STRUCTURE, LATTICE INSTABILITIES, AND METALLURGICAL PROPERTIES IN THE $LaIn_3$-$LaSn_3$ PSEUDOBINARY ALLOY SYSTEM. Roy, P. K. New York; Columbia University (1973). 107p. University Microfilms Order No. 74-12,759.

Thesis (Ph. D.).

Several bulk properties of the alloy system $La(Sn_xIn_{1-x})_3$ were studied systematically as a function of the electron/atom ratio by varying x. The superconducting transition temperature (T_c), the electronic specific heat coefficient (γ) and the Debye temperature (θ_D) have been measured to evaluate the electron-phonon coupling constant (λ) and the electronic density of states at the Fermi surface [N(O)], based on McMillan's theory, as a function of x. The electron-phonon interaction strengths (V_{ph}) which are proportional to the average squared electron-phonon matrix elements ($\bar{I}^2$) were then determined from λ and N(O). The phase diagram and structural aspects of the pseudobinary have been investigated by optical metallography, microhardness, differential thermal analysis, and x-ray and neutron diffraction measurements, to make meaningful interpretations of the superconducting properties in terms of electronic and lattice properties. T_c, γ, N(O) and λ displays a dramatic oscillatory variation with x, similar to the thermopower and the magnetic susceptibility data observed previously in the alloy system. (MHR)

25498 MAGNETIC STRUCTURE OF SUPERCONDUCTING THIN FILMS. Dolan, G. J. Ithaca, NY; Cornell Univ. (1974). 289p. University Microfilms Order No. 74-17,198.

Thesis (Ph. D.).

A comprehensive investigation of the magnetic structure of films of Pb, Sn and In is presented. The magnetic structures were observed by depositing ferromagnetic particles on the superconducting surfaces in magnetic fields perpendicular to the film planes. The Bitter patterns obtained in this way were observed by transmission electron microscopy or by light microscopy. (MHR)

Equipment and Devices

Refer also to abstract 24831.

25499 (IAE-2292) EFFECT OF RADIATION DAMAGES ON THE PROPERTIES OF TECHNICAL SUPERCONDUCTORS. Mikhailov, N. N.; Sotnikov, G. V.; Chernoplekov, N. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 24p. (In Russian). INIS.

The role of structural defects in the problem of increasing the critical current of industrial superconductors was examined. Experiments, revealing the individual aspects of the process of the effects of radiation on superconductors, were carried out. A careful selection of materials, type of bombarding particles and their energy, and the irradiation and subsequent annealing temperatures was made. (tr-auth)

25500 (ITEF-20) TESTING OF MODEL STABILIZED SUPERCONDUCTING MAGNETIC SYSTEM WITH INNER DIAMETER 700 mm. Vetlitskii, I. A.; Belonogov, A. V.; Dobrov, V. M.; Krylov, V. L.; Lebedev, A. V.; Lomkatsi, G. S.; Nilov, A. F.; Smolyankin, V. T. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 24p. (In Russian). INIS.

A stabilized superconducting magnet system was designed, constructed, and tested. The basic parameters of the system, its construction, and the results of tests made for studying the stabilization conditions and the origin of induced currents in the windings were examined. (tr-auth)

25501 (JINR-P8-7855) MODEL OF A HIGH-CURRENT AND HIGH-VOLTAGE SUPERCONDUCTING SWITCH. Menke, Kh.; Shishov, Yu. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab of High Energy). 1974. 25p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The problems concerning the construction and manufacture of switches, working in the circuits for energy evacuation from superconducting magnets or for energy transfer from inductive storage systems, are discussed. Nb-Ti filaments 65 μm in diameter embedded in epoxy resin were used. A model switch with thermal control was manufactured. It was tested in an experimental set-up made at the Cryogenic Division of the Laboratory of High Energies of JINR. The following parameters have been obtained: critical current 920 A, resistance in the normal state 2.5 Ohms, minimal switching time 0.35 msec. (auth)

25502 (UCSD-34P143-45) PRINCIPLES AND METHODS OF LOW FREQUENCY ELECTRIC AND MAGNETIC MEASUREMENTS USING AN RF BIASED POINT CONTACT SUPERCONDUCTING DEVICE. Giffard, R. P.; Webb, R. A.; Wheatley, J. C. (California Univ., La Jolla, San Diego (USA). Dept. of Physics). [nd]. Contract AT(04-3)-34. 160p. Dep. NTIS $11.00.

A comprehensive study has been made of some low frequency electric and magnetic measurements which can be made using an rf biased point contact superconducting device of the symmetric two-hole type introduced by Zimmerman. The paper begins with a qualitative description of the phenomena which are observed and utilized in making the measurements. A semiquantitative and semi-empirical analysis is made of the weakly superconducting system as it interacts with the radiofrequency field. Reasonable agreement between the analysis and experiment is obtained, thereby establishing a basis for optimization of conditions for measurement. Empirical data are also given as needed on coupling coil characteristics. Noise in the measuring system is discussed and the characteristics of the flux-locked loop used in the measurements introduced. It is shown that the total observed noise may be divided into at least three parts: one intrinsic to the sensor, one which reflects voltage noise in the amplifier, and one coupled into the instrument by the measuring circuit. The noise power spectra of the first two are shown to be comparable in an actual system. Below 100 Hz the spectrum, relative to the square of the flux quantum, is white and estimated by 10^{-8} Hz^{-1}. The characteristics are discussed of a dc voltmeter using a flux-locked loop and having a relatively high input impedance and good noise figure. An experimental study of noise is presented. A particular case with subpicovolt sensitivity limited by Johnson noise is discussed. Low frequency ac measurements of resistance, self-inductance, and mutual inductance are discussed using a novel bridge circuit and the superconducting sensor in a flux-locked loop as null detector. The noise characteristics are described and studied experimentally. Extreme sensitivity is achieved, both in resistance and inductance. A 1 $\mu\Omega$ resistor may be measured with a precision of 1 part in 10^5 with sub-picowatt power dissipation. Measurements of the mutual inductance due to a 1.6 mg crystal of CMN are described in which the crystal temperature was reduced to the millidegree region. Measurements of static magnetization are discussed and the ideas applied to measurement of temperature using milligram quantities of CMN. Measurements using a pair of thermometers, one inside and the other outside the mixing chamber of a dilution refrigerator, are presented. The concept of a device noise temperature is introduced and shown to be in the microdegree region. A very simple Johnson noise thermometer is then described. Measurements with this thermometer in the mixing

chamber of a dilution refrigerator were carried out to 12 m°K, the effective device temperature being measured to be (–1.4 ± 2.3)m°K. A qualitative experimental estimate places the actual device temperature well below one millidegree. A technical discussion of the flux-locked loop and of noise is given. (auth)

25503 COSINE AND OTHER TERMS IN THE JOSEPHSON TUNNELING CURRENT. Harris, R.E. (United Aircraft Research Laboratories, East Hartford, Connecticut 06108). Phys. Rev. B 10: No. 1, 84-94 (1 July 1974).

To second order in perturbation theory the tunneling current between two superconductors can be expressed as follows: $I(V,T) = I_{J1}(V,T) \sin\phi + I_{J2}(V,T) \cos\phi + I_{qp}(V,T)$, where V is a constant voltage across the tunneling barrier, T is the temperature, and $\phi = -2eVt/\hbar + \phi_0$ is the difference in the phases of the wave functions of the superconductors on each side of the barrier. Numerical evaluations of each of the terms are presented as functions of voltage for several temperatures. For the second term we find a different sign from that found in previous numerical work. When the superconductors on each side of the tunneling barrier are different, structure occurs at a voltage corresponding to the difference in the energy gaps. For the first two terms this structure was previously unrecognized. In addition, it is shown that the term in $\cos\phi$ has no effect upon rf-induced steps in the time-average current–voltage curve for a tunneling junction biased by a voltage source. Finally a relation is discussed between tunneling and other experiments such as far-infrared absorption and acoustic attenuation in superconductors. It is shown that tunneling can be thought of in terms of a slight generalization of the coherence effects which dominate the other kinds of experiments. (auth)

25504 JOSEPHSON JUNCTION DETECTORS. Clarke, J. (Univ. of California, Berkeley). Science; 184: No. 4143, 1235-1242(21 Jun 1974).

The principles of the Josephson effect are explained, the making of practical devices is described, and some of the applications are discussed. The applications are divided into two broad classes. The first involves the measurement of voltages, magnetic fields, magnetic field gradients, and magnetic susceptibilities at or below audio frequencies. The second class is concerned with the detection of high-frequency (microwave and far-infrared) electromagnetic radiation. (MHR)

25505 SUPERCONDUCTIVITY: LARGE-SCALE APPLICATIONS. Hein, R. A. (Naval Research Lab., Washington, DC). Science; 185: No. 4147, 211-222(19 Jul 1974).

An overview is presented of areas involving large-scale applications of superconductivity for which the 1970s are a decade of critical dicision. The following topics are covered: superconducting solenoids, high-energy physics, electric power transmission, rotating electrical machinery, energy storage and transfer, and superconducting magnets for superfast trains. (MHR)

PHYSICS (NUCLEAR)

25506 (AERE-PR/NP-20) NUCLEAR PHYSICS DIVISION PROGRESS REPORT FOR THE PERIOD 1st APRIL 1972–31st MARCH 1973. Blair, I. M.; Conlon, T. W. (eds.). (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1974. 109p. Dep. NTIS (U. S. Sales Only) $8.50.

The report falls under the following headings: nuclear data for reactors; nuclear data for fusion reactors; nuclear studies; interdisciplinary research (such as Moessbauer studies of biological molecules, chemical compounds and alloys, and studies in connection with astronomy); miscellaneous techniques; radioisotope and industrial physics; accelerator operation, maintenance and development; and reports, publications and conference papers. (UK)

For title listings of selected papers see: 23499, 23550, 24833, 25542–25544, 25572, 25607, 25659, and 25660.

Neutron Interactions with Matter

Refer also to abstracts 25582 and 25736.

25507 (CONF-721018-(Vol.4), pp 1202-1219) THEORETICAL STUDIES OF THE SENSITIVITY OF NEUTRON TRANSPORT IN IRON TO CROSS SECTION PROPERTIES. Goldstein, H.; Lidofsky, L. J.; Preeg, W.; Troubetzkoy, E.; Oblow, E.; Ching, J. (Columbia Univ., New York). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The combined process of neutron transport and slowing down is considered as motion in six-dimensional neutron phase space comprising the ordinary three spatial coordinates plus the coordinates that specify neutron direction and energy. The interpretation of some transport calculations of neutron penetration in iron for two different geometries is discussed. (CES)

25508 (CONF-721018-(Vol.4), pp 1220-1231) PROBABILITY TABLE METHOD FOR HANDLING UNRESOLVED RESONANCES IN MONTE CARLO CALCULATIONS. Levitt, L. B. (Atomics International, Canoga Park, CA). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The representation of neutron cross section data in the unresolved resonance energy range in a way suitable for continuous energy Monte Carlo calculations is limited severely by the high speed memory size of even the largest computers. A new approach, known as the Probability Table Method, has been developed. The basic idea of the method is to represent the neutron cross section at a given energy, not by a unique value, $\sigma(E)$, but by a distribution function, in tabular form, whose mean value is the infinite dilution smooth average value, $\bar{\sigma}(E)$. Recent success in using these tables in both Monte Carlo and analytical calculations indicate that probability tables could serve as a standard way of representing neutron cross sections in the unresolved resonance energy range. (auth)

25509 (CONF-721018-(Vol.4), pp 1232-1248) ANISOTROPY OF PHOTON EMISSION IN TRANSPORT CALCULATIONS. Dudziak, D. J.; Bosler, G. E. (Los Alamos Scientific Lab., NM). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Photon production data, including angular distributions, presently exist in the ENDF for several materials. The LAPH series of codes were developed to compute Legendre moments of multigroup photon-production matrices. Initial investigations were made into the effects of photon-emission anisotropy on flux distributions. Coupled neutron–photon transport calculations were performed with the DTF-IV code. Comparisons of P_3 scattering calculations, using P_0 and P_2 photon-production matrices, were made for a fission source in 5 meters each of sodium and concrete. Total fluxes between P_0 and P_3 approximations differed by up to 11% in photon groups containing anisotropically emitted photons. (auth)

25510 (CONF-721018-(Vol. 5), pp 1427-1443) INTERCOMPARISON OF DIFFERENT METHODS TO CALCULATE NEUTRON TRANSPORT ALONG SODIUM DUCTS. Amin, E. (Univ., Stuttgart); Diettrich, O.; Futtermenger, W.; Groenefeld, G.; Hehn, G.; Herrnberger, V.; Schmidt, F.; Vogt, H.; Vossebrecker, H. 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

An intercomparison has been completed for programs capable of dealing with two-dimensional shielding problems. The programs used are the S_N-program DOT II, the group Monte Carlo programs MORSE-K and TIMOC-71, the point Monte Carlo programs UNC-SAM2 and TRAPAR and a modified diffusion code DLS. As a test example the streaming of neutrons along a sodium coolant pipe of a fast breeder reactor was chosen. The comparison was made with the following quantities: axial and radial distribution of fluxes and reaction rates, neutron energy spectra at different penetration depths, and machine time needed. (auth)

25511 (CTH-RF-25) MONTE CARLO INVESTIGATION OF QUASI-EXPONENTIAL DECAY OF PULSED NEUTRON FIELDS IN WATER. Roennberg, G. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Reaktorfysik). 1973. 148p. Dep. NTIS (US Sales Only) $10.50.

Thesis.

Monte Carlo simulations have been performed of pulsed neutron source experiments on very small H_2O spheres and on spherical shells of H_2O. The Haywood scattering model was used and both fast and slow source neutrons were simulated. It was verified that the decay in very small spheres is nonexponential with decay rates above the Corngold limit if fast source neutrons are used. However, with slow source neutrons the decay was found to be quasi-exponential. The decay constants are above the Corngold limit and depend on the size of the sphere and on the initial neutron velocity. A theoretical explanation has been proposed, which is based on the diffusion of elastically scattered slow neutrons. The decay in spherical shells with fast source neutrons was found to be quasi-exponential if the cavity is small. With a larger cavity, the decay was found to be non-exponential, the decay rate decreasing with time as well as the mean neutron velocity in the cavity. A comparison has been made with one-group P_1 theory. The agreement is rather good especially if the mean velocities from the simulations are introduced. The decay in a thin shell has been examined also with slow source neutrons. The decay was found to be quasi-exponential with the decay constant depending on the initial velocity. A theoretical explanation has been proposed, which is analogous to the theory for very small spheres. The influence of the initial values on the quasi-exponential decay in a sphere with a small central cavity has been examined both theoretically and by simulations with slow source neutrons. It has been shown that source neutrons with velocities below a critical limit may distort the decay. (auth)

25512 (IAE-2265) GREEN'S FUNCTION FOR NEUTRON TRANSPORT EQUATION IN CYLINDRICAL GEOMETRY WITH AZIMUTHAL ASYMMETRY. Laletin, N. I.; Sultanov, N. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 16p. (In Russian). INIS.

A system of elementary solutions (in the Case sense) of the one-velocity neutron transport equation for cylindrical geometry with consideration of spatial azimuthal asymmetry was found. The system obtained was used for the construction of Green's functions for the transport equation for monoenergetic neutrons for cylindrical sources in an infinite homogeneous medium with intensity depending on the azimuthal angle. The Green's functions were obtained in a form easy to use in the method of surface pseudosources. (tr-auth)

25513 (IAE-2300) MONTE CARLO METHOD CALCULATION OF ENERGY, TIME, AND ANGULAR CHARACTERISTICS OF NEUTRON SLOWING-DOWN IN SOME SUBSTANCES WITH A < 10. Peregudov, V. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 16p. (In Russian). INIS.

The energy spectra and time and angular distributions of neutrons on emergence from a moderator were calculated by the Monte Carlo method. Uranium targets were used as fast-neutron sources. In the targets the neutrons were formed as a result of photonuclear reactions occurring under the effects of bremsstrahlung from electrons extracted from an accelerator. Polyethylene, heavy water, and Be were used as moderators. (3 figures, 8 tables) (tr-auth)

25514 (JAERI-1230) CROSS SECTION DATA AND SPECIFICATIONS OF AGLI/0 FOR FAST REACTOR ANALYSIS: ADJUSTED GROUP LIBRARY BY INTEGRAL DATA. Kuroi, H.; Tone, T. (Japan Atomic Energy Research Inst., Tokyo). Aug 1973. 34p. NTIS (US Sales Only).

In order to satisfy the accuracy required in the recent analysis of integral data within a reasonable computer time, the cross section library AGLI which mediates between the usual concept of group constants and nuclear data such as ENDF/B is produced.

Two major features are imposed upon the AGLI library: one is that it can be used as input to the spectrum generating code without any time-consuming procedures, and the other is that it should be of convenient form to adjust the cross section by utilizing various integral data measured in critical assemblies. In the library, the total, fission and absorption cross sections are given by 1950-energy groups of equi-lethargy width with the so-called histogram representation of the self-shielding correction factor, and the inelastic scattering cross sections are given level-wise with the same energy group structure as in the other cross sections. The number of neutrons per fission and the Legendre coefficients of the angular distribution of scattering are expanded by Chebychev polynomials with respect to the lethargy, and these expansion coefficients are stored on the file. The nuclides provided so far are ^{235}U, ^{238}U, ^{239}Pu, ^{240}Pu, ^{241}Pu, Fe, Cr, Ni, Na, Al, O, C, Mn, Mo, Pb, Cu, ^{10}B, ^{11}B and H. The AGLI/0-th version has been produced and used together with the computer code system DOYC for the analysis of various integral data, and has been connected with the on-line adjusting system ARCADIA. As a result the AGLI-library is shown to fulfill satisfactorily the requirements mentioned above. This report belongs among serial reports which describe the DOYC computer software system developed for analyses relative to fast reactor physics. (JA)

25515 (JAERI-M-5527) PEACO-II: A CODE FOR CALCULATION OF EFFECTIVE CROSS SECTIONS IN HETEROGENEOUS SYSTEMS. Ishiguro, Y. (Japan Atomic Energy Research Inst., Tokyo). Jan 1974. 20p. NTIS (U. S. Sales Only).

The methods used in the PEACO-II code to solve the integral transport equations in heterogeneous systems are summarized; the systems consist of an infinite number of cells with slab, cylindrical, square or hexagonal geometry. The RABBLE Method is used to calculate the neutron slowing-down source, and the heterogeneity is treated by the first-flight collision probability method. For calculation of the collision probability, an interpolation method is introduced. PEACO-II is a revised version of the PEACO code, and it is coded in FORTRAN-IV of the FACOM-230/60 machine. A core memory of 100 K bytes will be required for a problem having 30 regions in the cell, 10 materials including 3 resonance-absorbing materials, and 10 compositions. (auth)

25516 (UCID-15604) MONTE CARLO CALCULATIONS OF NEUTRON ATTENUATION. Czirr, J. B.; Van Hemert, R. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Feb 1970. 7p. Dep. NTIS $4.00.

Monte Carlo calculations of the neutron transmission for boric acid, lithium carbonate, paraffin, borated polyethylene, and concrete are reported. Monoenergetic, flat, and 1/E incident neutron spectra were investigated. (2 figures, 2 tables) (auth)

25517 (UCID-15676) MESNE, A CROSS SECTION AVERAGING CODE. Aron, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1967. 27p. Dep. NTIS $4.50.

MESNE is a code designed to produce group-averaged cross sections and group transfer cross sections for use in multigroup codes from microscopic cross section data. The microscopic data used are contained in the LRL-evaluated neutron cross section library. MESNE was written to perform the averagings with no integration error; input was to be simple, and the running time, as short as possible. MESNE is coded totally in FORTRAN II for the IBM 7094. MESNE is organized as a two-link chain job. The subroutines, input data, etc., are described in detail. (RWR)

25518 (USC-113P-56) COMPUTATIONAL AND ANALYTIC APPROACHES TO RADIATIVE TRANSFER AND NEUTRON TRANSPORT THEORY. Technical Report No. RB73-46. Poon, P. T. Y. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Sep 1973. Contract AT(04-3)-113. 170p. Dep. NTIS $5.00.

Thesis.

This study applies a combination of different computational and analytic methods to a variety of problems in radiative transfer and neutron transport theory with a special emphasis on invariant imbedding, and constructs numerical algorithms for the individual problems. The particle counting technique of the invariant imbedding approach is employed to give a detailed analysis or order-of-scattering theory in slabs of finite thickness. Systems of integrodifferential recurrence equations and integral recurrence relations for the finite-order scattering and transmission functions are derived. A generalization to take into account inhomogeneity and anisotropy is made, and a reduction in dimensionality is achieved via the finite order X and Y functions. The star product of scattering matrices together with the reflection and transmission integral operators is utilized to derive the doubling equations for a homogeneous anisotropically scattering slab, the adding equations for a composite slab, and the reduction formulas of plane-parallel slabs bounded by specular or Lambert reflectors. The resolvent kernel method from an invariant imbedding approach is used to obtain a Cauchy system for the scattering and transmission functions for an inhomogeneous isotropically scattering slab bounded by a hybrid of Lambert and specular reflectors. As a by-product, this approach may also be applied to construct a numerical algorithm for the solution of Fredholm integral equations of the second kind with composite displacement kernels. With the aid of invariant imbedding, the method of discrete ordinates, the resolvent kernel method, and differential quadrature, numerical algorithms were constructed for the computation of the following functions: finite-order X and Y functions for slabs of finite thickness, reflected and transmitted intensity patterns for an inhomogeneous slab bounded by a hybrid of Lambert and specular reflectors, Sobolev's phi function for planar and spherical scattering media, and diffusely reflected intensity patterns from a spherical shell surrounding a perfectly absorbing core, a vacuum core, or with a diffusely reflecting inner surface. Tabulated results or graphs generated by each of the numerical algorithms for different illustrative cases are given. (14 figures, 21 tables) (auth)

25519 MULTIPLE SCATTERING FOR THERMAL NEUTRONS. Kalin, T.; Pahor, S. (Institut Jozef Stefan, Ljubljana (Yugoslavia); Ljubljana Univ. (Yugoslavia). Dept. of Physics). Atomkernenergie; 23: No. 3, 190-194(1974).

4 figs.; 7 refs.

A new method for multiple scattering corrections in double differential cross section measurements has been tested numerically for a case of velocity-dependent quadratically anisotropic scattering of thermal neutrons. Contrary to the present methods, it does not assume in advance any model for the scattering function of the measured sample. The results of a numerical experiment have shown that the proposed method works well, even up to the slab thickness when further increases in thickness do not result in appreciable gain in scattered neutron density. (auth)

25520 NEUTRON DEPOLARIZATION IN MnF_2. Gordeev, G. P.; Drabkin, G. M.; Lazebnik, I. M.; Aksel'rod, A. A.; Toperverg, B. P. (Inst. of Nuclear Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 4, 135-136(20 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 4, 220-222(20 Feb 1974).

Depolarization of a beam of polarized neutrons passing through a sample was observed in the region of T_N as well as $T \ll T_N$. Estimates explain the depolarization at $T \sim T_N$ as being due to the existence of magnetic fluctuations (long-wave spin waves), and at $T \ll T_N$ as being due to the presence of inhomogeneous magnetization regions such as domains. (auth)

25521 ENERGY AND SPACE DEPENDENCE OF D + T NEUTRONS IN SMALL SAMPLES OF IRON, ALUMINUM, AND LUCITE. Ozyol, H.; Barutcugil, E.; Ozmutlu, C. (Ankara Nuclear Research Center). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 1, 3-14(Feb 1974).

The induced activity variations of Cu, Al, and In detectors located in r and z directions of iron, aluminium, and lucite samples 4 cm dia and 7 cm long were measured. On the basis of these activity measurements and the excitation functions of threshold detectors, the relative neutron flux distribution for the energy intervals of 14 to 12.9 MeV, 12.9 to 6.0 MeV, 6.0 to 1.65 MeV, and thermal region was obtained. Semiempirical relationships were derived for the neutron flux distribution in r and z directions. Flux distribution in r direction is found to be represented by cosine function for all energies, and the one in z direction by the sum of two exponential functions for energies other than thermal energy and also by cosine function for thermal energy. (9 figures) (auth)

25522 POLARIZED NEUTRONS AND NUCLEI: NUCLEAR PSEUDOMAGNETISM. Abragam, A.; Bacchella, G. L.; Glattli, H.; Meriel, P.; Piesvaux, J.; Pinot, M.; Roubeau, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). pp 1-10 of Magnetic Resonance and Related Phenomena. Hovi, V. (ed.). Amsterdam; North-Holland Publishing Company (1973).

From 17th Congress AMPERE on magnetic resonance and related phenomena; Turku, Finland (21 Aug 1972).

The nuclear pseudomagnetic resonance of the neutron induced by a nuclear pseudomagnetic rf field has been observed. A description of the experiment is given. It could be applied in the measurement of the average polarization of polarized proton targets and also in the measurement of the spin dependent part of the nuclear scattering amplitude. (NL)

Nuclear Properties and Reactions, $A \leq 5$

Refer also to abstracts 25253, 25271, 25273, 25294, and 25429.

25523 (UCID-15510) PHOTONEUTRON CROSS SECTIONS FOR ^{3}He AND ^{4}He. Berman, B. L.; Fultz, S. C.; Yergin, P. F.; Kelly, M. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Jul 1969. 10p. Dep. NTIS $4.00.

The photoneutron cross sections for ^{3}He and ^{4}He were measured with monoenergetic photons from threshold to 30 MeV. (2 figures, 1 table) (auth)

25524 MICROSCOPIC DESCRIPTION OF γ-INDUCED ^{4}He BREAK-UP PROCESSES. Stoewe, H.; Hackenbroich, H. H. (Koeln Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Phys.; 267: No. 5, 403-409(May 1974).

5 figs.; 1 tab.; 16 refs.

The theory of γ break-up processes in the cluster model reaction scheme is developed and applied to the ^{4}He case. The large difference between (γ,p) and (γ,n) cross sections reported in the literature is not found, but the result of this calculation agrees well with (γ,p) measurements. Furthermore, (γ,d) reactions are studied for low energies. (auth)

25525 MAGNETIC FORM FACTOR OF ^{3}He. Brandenburg, R.A.; Kim, Y.E. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544); Tubis, A. Phys. Rev. Lett. 32: No. 23, 1325-1327 (10 June 1974).

The ^{3}He magnetic form factor is calculated in the impulse approximation using a wave function obtained previously from a complete solution of the Faddeev equations with the Reid soft-core potential. The S-D matrix elements contribute significantly. The convection current contribution is found to be small. The form factor has a minimum at $Q^2 = 7.1$ fm^{-2}. (auth)

25526 PROTON-DEUTERON DOUBLE SCATTERING. Wilson, J.W. (NASA, Langley Research Center, Hampton, Virginia 23665 and College of William and Mary, Williamsburg, Virginia 23185). Phys. Rev. C 10: No. 1, 369-376 (July 1974).

A simple but accurate form for the proton-deuteron elastic double scattering amplitude, which includes both projectile and target recoil motion and is applicable at all momentum transfer, is derived by taking advantage of the restricted range of Fermi momentum allowed by the deuteron wave function. This amplitude can be directly compared to approximations which have neglected target recoil or are limited to small momentum transfer; the target recoil and large momentum transfer effects are evaluated explicitly within the context of a Gaussian model. (auth)

25527 FADDEEV APPROACH TO PION PRODUCTION AND PION-DEUTERON SCATTERING. Afnan, I.R.; Thomas, A.W. (School of Physical Sciences, The Flinders University of South Australia, Bedford Park, South Australia, 5042, Australia). Phys. Rev. C 10: No. 1, 109-125 (July 1974).

Some consequences of a new approach to pion production are explored in the threshold region. We treat the πNN system as a three-body system, with absorption (or production) occurring because of the existence of a πN bound state in the P_{11} (nucleon) channel. This description of the NNπ vertex is justified by successfully using the model to calculate the long range part of the N-N scattering amplitude. The results of the pion production calculation confirm a sensitivity to the short range behavior of the deuteron wave function and its D-state probability reported earlier. We also find a stronger variation of the production amplitude with energy than has previously been reported. This may resolve the apparent incompatibility of some experimental results. Finally, we also discuss the implications of the model for pion-deuteron elastic scattering. (auth)

25528 DEUTERON ELECTROMAGNETIC STRUCTURE AT LARGE MOMENTUM TRANSFER. Chemtob, M. (Service de Physique Theorique, Centre d'Etudes Nucleaires de Saclay, 91190 Gif-sur-Yvette, France); Moniz, E.J.; Rho, M. Phys. Rev. C 10: No. 1, 344-352 (July 1974).

Pursuing the idea that exchange currents should dominate the very large momentum transfer behavior of the deuteron electromagnetic form factors, we evaluate the $\pi\rho$ and $\sigma\omega$ exchange contributions. Taking the meson-nucleon coupling constants from one-boson exchange calculations of the NN force and the photon-meson coupling strengths from a relativistic quark model, we find that the form factors begin to "flatten out" at momentum transfers $q^2 \gtrsim 50$ fm^{-2} and are an order of magnitude greater than the usual impulse prediction at q^2 100 $\approx$ fm^{-2}. (auth)

25529 STUDY OF DIRECT-REACTION MECHANISMS AND THE DISTORTED-WAVE BORN APPROXIMATION IN THE α-(p, d)^{3}He REACTION. Chwieroth, F.S.; Tang, Y.C.; Thompson, D.R. (School of Physics, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. C 10: No. 1, 406-408 (July 1974).

A detailed analysis of our calculation on the α (p, d)^{3}He reaction using the resonating-group method shows that, at sufficiently high energies, the differential reaction cross section can be well accounted for in the forward angular region by a one-nucleon pickup process and in the backward angular region by a two-nucleon pickup process. Also, it is found that even at relatively low energies, the distorted-wave Born approximation or weak-coupling approximation is reasonably valid for this reaction. (auth)

25530 VARIOUS CROSS SECTIONS FOR A $\leq$ 3 NUCLEI. Jarmie, N.; Jett, J.H. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. C 10: No. 1, 54-56 (July 1974).

Differential cross section data, accurate to an error of less than 1%, are presented for several different elastic scatterings and reactions, in the region of 10-14 MeV. The data are for various processes stemming from the bombardment of hydrogen, deuterium, ^{3}He, and tritium by protons and deuterons. (auth)

25531 POLARIZED PROTONS ON ^{3}He AT 13.6 MeV. Jarmie, N.; Jett, J.H. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. C 10: No. 1, 57-59 (July 1974).

Accurate analyzing powers for the scattering of polarized protons by ^{3}He have been measured at 13.600 MeV. They confirm previous measurements and leave a significant difference between n + ^{3}H and p + ^{3}He analyzing powers at 22 MeV unexplained. The data are currently being used in a general energy-dependent analysis of the p + ^{3}He system. (auth)

25532 CALCULATION OF ^{3}H AND ^{3}He ELECTROMAGNETIC FORM FACTORS WITH HARD-CORE TWO-NUCLEON POTENTIALS USING THE UNITARY POLE APPROXIMATION. Maheshwari, C.; Mathur, V.S. (Department of Physics, Banaras Hindu University, Varanasi-221005 India). Phys. Rev. C 10: No. 1, 425-426 (July 1974).

The triton wave function for a two body spin-dependent hard-core potential of exponential shape is obtained by solving the Faddeev three-body equations in the unitary pole approximation. It is then used to calculate the ^{3}H, ^{3}He electromagnetic form factors. As anticipated by Gupta et al., the hard core is found to partially account for the difference between the rms charge radii of ^{3}He and ^{3}H which remains unexplained even after considering the S' state admixture as well as the neutron charge form factor. (auth)

25533 SEPARABLE POTENTIAL FOR THE α-α INTERACTION. Rahman, M.; Husain, D.; Ali, S. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. C 10: No. 1, 1-3 (July 1974).

A nonlocal separable interaction of Mongan type has been used to study S-, D-, and G-wave α-α scattering phase shifts up to a bombarding energy of 24 MeV. Calculations have been made in the coordinate representation in which the Coulomb effects have been taken into account exactly. A separable representation of the α-α interaction is found to be satisfactory. (auth)

25534 PARAMETRIZATION OF σ_{tot} σ (θ), and P(θ) FOR 25-100 MeV NP ELASTIC SCATTERING. Binstock, J. (Department of Physics and Cyclotron Institute, Texas A&M University, College Station, Texas 77843). Phys. Rev. C 10: No. 1, 19-23 (July 1974).

We present a parametrization of the ^{1}H(n,n)^{1}H total cross section, differential cross section, and polarization, for the neutron lab kinetic energy range 25-100 MeV. The observables we parametrized are computed from the phase shifts of the Bryan-Gersten potential-model constrained fit to all of the available 0-450 MeV np and pp elastic scattering data. We find out parametrization of σ (θ) to differ significantly from the Gammel formula, in that for all energies 25-100 MeV we have higher σ (180°)/σ (90°) ratios, as well as σ (θ) shapes which are nonsymmetric about 90° c.m. Our total cross sections begin to differ from the Gammel formula at neutron energies above 50 MeV, where the Gammel formula was never meant to apply anyway. (auth)

25535 MESON EXCHANGE EFFECTS ON THE CHARGE FORM FACTORS OF THE TRI-NUCLEON SYSTEM. Kloet, W. M. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy); Tjon, J. A. (Rijksuniversiteit Utrecht (Netherlands). Instituut voor Theoretische Fysica). Phys. Lett., B; 49: No. 5, 419-422(13 May 1974).

The presence of meson exchange currents in the tri-nucleon system is shown to modify significantly the charge form factor of ^{3}He in the region of the dip and the secondary maximum. As a result the form factor is considerably changed at high momentum transfer. (auth)

25536 VECTOR ANALYZING POWER OF THE REACTION D(d,p)T AT 12.6 MeV ENERGY. Zaika, N. I.; Kibkalo, Yu. V.; Nemets, O. F.; Semenov, V. S.; Shmarin, P. L.; Yasnogorodskii, A. M. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 6, 926-930(Jun 1974). (In Russian).

The vector analyzing power of the D(d,p)T reaction was measured at 12.6 MeV. There is no correlation between the small measured values of the vector analyzing power and large values of proton polarization. The vector analyzing power of both

mirror d–d reactions does not show a significant deviation from the charge symmetry. (3 figures, 1 table) (auth)

25537 TRITON BINDING ENERGY IN UPA WITH HARD-CORE SPIN-DEPENDENT POTENTIALS. Maheshwari, C.; Lagu, A. V.; Mathur, V. S. (Banaras Hindu Univ., India). Proc. Indian Nat. Sci. Acad., Part A; 39: No. 3, 151-157(May 1973).

Following the earlier work on the "unitary pole expansion" for hard-core potentials, a calculation for the binding energy of a three-particle system interacting according to Herzfeld potential (hard-core with square well shape) is done in the "unitary pole approximation". The value of the binding energy so obtained agrees well with that of Kim and Tubis (1970) from an exact three-body calculation. Subsequently, a UPA calculation for the triton binding energy is done using spin-dependent local potential with hard core and exponential shape. The results are compared with those of a variational calculation for the same potential done earlier. (auth)

25538 MECHANISMS IN THE REACTIONS $^3H + ^3He$ and $^3H + ^2H$ AND MEASUREMENT OF THE REACTION $^3H(p,^3He)n$ FROM 13.6 TO 32.8 MeV. Allas, R. G. (Naval Research Lab., Washington, DC); Beach, L. A.; Bondelid, R. O.; Diener, E. M.; Petersen, E. L.; Lambert, J. M.; Treado, P. A.; Slaus, I. Phys. Rev., C; 9: No. 2, 787-789(Feb 1974).

The angular distribution of the $^3H(p,^3He)n$ reaction cross section was measured at E_p = 13.6, 14.8, 18.0, 21.0, 24.0, 27.0, 30.0, and 32.8 MeV with an estimated absolute uncertainty of 8%. Such data are necessary in the study of quasi-free processes, which frequently are hampered by the lack of cross-section data of the corresponding free processes. Normalization to existing E_p = 13.6-MeV data shows that the ^3H content of the target is 1.7 times less than given by the supplier. With these new measurements, the $^3H + ^3He$ and $^3H + ^2H$ quasifree reactions are reanalyzed. (3 figures, 2 tables) (auth)

25539 16.7-MeV STATE OF ^5He IN THE CLUSTER MODEL. Jain, V. K.; Srivastava, B. B. (Meerut Univ., India). Indian J. Pure Appl. Phys.; 12: No. 2, 117-120(Feb 1974).

The binding energy of the 16.7-MeV, $(\frac{3}{2})^+$ state in ^5He was calculated in the cluster model by using a variational procedure. The state is considered to have a triton–deuteron cluster structure. An improved nuclear two-body interaction and three-Gaussian deuteron wave function were used. An improved value of −8.52 MeV for the binding energy was obtained. (auth)

25540 THREE-BODY MODEL FOR ALPHA PARTICLE-INDUCED DEUTERON BREAKUP. Wuller, C. E. Jr. Columbia, MO; Univ. of Missouri (1973). 133p. University Microfilms Order No. 74-18,675.

Thesis (Ph. D.).

A study was made of the three-particle description of the $D(\alpha,\alpha p)n$ reaction. The scattering problem is posed in the three-particle potential theory framework originated by Faddeev. Separable interactions are introduced for the two-body input. A complete angular momentum reduction is given for the system of coupled integral equations for the transition amplitudes. A series of assumptions is made to reduce the full system of equations to a practical model for calculation. Comparison of model predictions to kinematically complete cross section data shows that the data are dominated by the nucleon–alpha particle P-wave resonance, which is included in an impulse-approximation treatment, and by the quasi-free scattering effect, whose magnitude is not accounted for by the S-wave part of the full three-body equations. (Diss. Abstr. Int., B)

25541 STUDY OF THE ALPHA PLUS ALPHA SYSTEM BELOW 30 MeV (LAB). Chien, J. W. S. Minneapolis; Univ. of Minnesota (1974). 234p. University Microfilms Order No. 74-17,234.

Thesis (Ph. D.).

Differential cross sections for $\alpha + \alpha$ elastic scattering were measured at lab energies of 18.00, 21.12, 24.11, 25.50, 26.99, 28.50, and 29.50 MeV. The majority of the data had relative errors less than 1%, and the additional error in absolute scale was 0.30%. A phase-shift analysis of the data was performed, and most of the phase shifts were determined to an accuracy of less than 1/3°. These phase shifts were compared with those calculated from R-matrix theory, resonating-group theory, and a phenomenological potential model. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 23510, 25303, 25332, 25428, 25572, 25577, 25584, 25611, 25612, and 25623.

25542 (AERE-PR/NP-20, pp 24-26) $\frac{1}{2}^-$ LEVEL AT 0.25 MeV IN THE $^6Li + n$ REACTION. Uttley, C. A. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1974.

25543 (AERE-PR/NP-20, p 29) NEUTRON TOTAL CROSS SECTION MEASUREMENTS. Moxon, M. C.; Endacott, D. A. J.; Jolly, J. E. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1974.

25544 (AERE-PR/NP-20, pp 35-36) MEASUREMENTS OF STANDARD CROSS SECTIONS USING THE HARWELL BLACK DETECTOR. Coates, M. S. (Atomic Energy Research Establishment, Harwell, Eng.); Hunt, G. J.; Uttley, C. A. Jan 1974.

25545 (FRNC-TH-483) STUDY OF ^{12}C EXCITED STATES CORRESPONDING TO EXCITATION OF BETWEEN 16.5 MeV TO 19.2 MeV USING $^{11}B(p,3\alpha)$ AND $^{11}B(p,p)^{11}B$ REACTIONS. Chanut, Y. (Lyon-1 Univ., 69 – Villeurbanne (France)). 1973. 154p. (In French). Dep. NTIS (U. S. Sales Only) $10.75.

Thesis.

The $^{11}B(p,3\alpha)$ reaction and $^{11}B(p,p)$ elastic scattering were studied for incident proton energies of between 1 and 3 MeV and 1 and 3.5 MeV, respectively. Studies of the $^{11}B(p,3\alpha)$ reaction established the existence of forbidden phenomena associated with the 18.36-MeV resonance in the final 3-α particle state, one of these α particles having a kinetic energy of zero. This forbidden phenomenon is consistent with a $J^\pi = 3^-$ state of ^{12}C. The investigation was extended to other specifically final-state-interaction situations: 3 α particles of equal kinetic energy; 2 α particles of identical kinetic energy from the $^{12}C \rightarrow \alpha + ^8Be$ (2.9 MeV) decomposition. The possibility of the direct (3α) decomposition of ^{12}C at 18.36 MeV was examined; constructive interference phenomena of the two following schemes were observed: $^{12}C \rightarrow \alpha_1 + ^8Be$ (2.9 MeV); $^{12}C \rightarrow \alpha_1 + ^8Be$ (2.9 MeV). Analysis of $^{11}B(p,p)$ elastic scattering enabled partial proton widths to be determined together with the correspondence between the T = 1 excited states of ^{12}B and their isobaric analogues in ^{12}C, this being accomplished from comparisons between reduced proton and neutron widths. (FR)

25546 (IAE-2229) MEASUREMENT OF THE MULTIPLICATION FACTOR FOR FISSION NEUTRONS FROM THE $^9Be(n,2n)$ REACTION IN BERYLLIUM AND BERYLLIUM OXIDE BY THE MANGANESE BATH METHOD. Zhezherun, I. F.; Taraban'ko, V. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 10p. (In Russian). INIS.

The multiplication factors for fission neutrons in the $^9Be(n,2n)$ reaction in beryllium and beryllium oxide were measured by the magnesium bath method. The neutron source was a ^{235}U converter located in the beam of a thermal neutron reactor (IRT-1000). (tr-auth)

25547 (JINR–P15-7971) STUDY OF THE REACTION $^{19}F(^3He,p)^{21}Ne$. Dzhanobilov, K.; Zalyubovskii, I. I.; Saad, Kh. R.; Sarana, V. D.; Sizov, I. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 22p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The excitation functions and angular distributions for several groups of protons from the reaction $^{19}F(^3He,p)^{21}Ne$ were studied in the range of bombarding-particle energies from 2.3 to 4.2 MeV. Comparison with Hauser–Feshbach theory showed that, at energies $E_{^3He}$ up to 3.0 MeV, the reaction occurs through the production of a compound nucleus. (8 figurs, 2 tables) (auth)

25548 (JINR–P15-8024) STUDY OF THE REACTION $^{10}B(^3He,p)^{12}C$. Dzhanobilov, K.; Saad, Kh. R.; Sizov, I. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 21p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The excitation functions and angular distributions (corresponding to the production of a final ^{12}C nucleus in the ground and first excited states) of protons from the reaction $^{10}B(^3He,p)^{12}C$ were measured by using the electrostatic generator of the LNP, JINR. The analysis of the proton angular distributions revealed a complicated character of ^3He interaction with ^{10}B nuclei that includes the mechanism of the compound-nucleus production and direct processes. (8 figures, 1 table) (auth)

25549 (JINR–P15-8025) STUDY OF THE REACTION $^{11}B(^3He,p_0)^{13}C$. Dzhanobilov, K.; Saad, Kh. R.; Sizov, I. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 25p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

Excitation functions and angular distributions of protons from the reaction $^{11}B(^3He,p_0)^{13}C$ in the energy range 1.5 to 4.3 MeV were measured by using the electrostatic generator of the LNP, JINR. The analysis of the proton angular distributions revealed a complicated character of ^3He interaction with ^{11}B nuclei that includes the mechanism of the compound-nucleus and direct processes. (6 figures, 1 table) (auth)

25550 (LA-UR-74-1143) ANGULAR DISTRIBUTIONS IN THE RADIATIVE CAPTURE OF 14-MeV NEUTRONS. Drake, D. M.; Arthur, E. D.; Halpern, I. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 6p. (CONF-740920-3). Dep. NTIS $4.00.

From second international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

Relative yields of capture photons were observed at 55°, 90°, and 125° for four nuclei in bombardments with 14-MeV neutrons. The yields from ^{10}B, ^{29}Si, and ^{40}Ca showed little fore–aft anisotropy, in contrast with those observed in proton capture, which generally peak forward. Neutron capture in ^{12}C was found to peak backward—this observation suggested the existence of a broad E2 resonance below the GDR. (3 figures, 1 table) (auth)

25551 DWBA ANALYSIS OF POLARIZATION OF PROTONS FROM THE ^{9}Be(d,p$_0$)^{10}Be REACTION AT E$_d$ = 4.0 AND 15.0 MeV. Bondouk, I. I. (Atomic Energy Establishment, Inshas (Egypt). Nuclear Physics Dept.). Atomkernenergie; 23: No. 3, 219–220 (1974).

1 fig.; 1 tab.; 21 refs.

The polarization of protons from the ^{9}Be(d,p$_0$)^{10}Be reaction has been analyzed in terms of the DWBA theory at deuteron energies of 4.0 and 15.0 MeV. Good fits were obtained which show the usefulness of the DWBA theory for describing polarization by using the suitable optical model parameters. (auth)

25552 VIOLATION OF ISOSPIN CONSERVATION IN TWO-NUCLEON PICKUP REACTIONS?. Crozier, D.J.; Fortune, H.T. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 10: No. 1, 377-378 (July 1974).

The recently reported differences in the analog reactions ^{16}O(p, ^{3}He)^{14}N (2.31 MeV) and ^{16}O(p, t)^{14}O (g.s.) are correctly predicted by distorted-wave Born-approximation calculations, using standard parameters with no adjustments. (auth)

25553 ^{9}Be(p,2n)^{8}B REACTION AS A NEUTRINO SOURCE. Davison, N.E.; Canty, M.J.; Dohan, D.A.; McDonald, A. (Physics Department, University of Manitoba, Winnipeg, Manitoba, Canada). Phys. Rev. C 10: No. 1, 50-53 (July 1974).

The ^{8}B yield from the ^{9}Be(p,2p)^{8}B reaction has been measured in the range of incident proton energies E$_p$ = 22.0 to E$_p$ = 47.5 MeV. The current of 47.5 MeV protons necessary to produce a flux of 0.74 × 10^{6} ^{8}B neutrinos per cm^2 sec (1 solar neutrino unit) at a distance of 8 m from a thick target is found to be 43±5 mA. (auth)

25554 PARITY NON-CONSERVATION IN THE ALPHA PARTICLE DECAY OF THE 8.87 MeV 2$^-$ STATE OF ^{16}O. Neubeck, K.; Schober, H.; Wäffler, H. (Nuclear Physics Division, Max-Planck-Institute for Chemistry, 6500 Mainz, Germany). Phys. Rev. C 10: No. 1, 320-332 (July 1974).

The energy spectrum of 2.5 × 10^{8} α particles from the sequential decay ^{16}N(β^-)^{16}O(α)^{12}C has been analyzed. Superimposed on the broad energy distribution which originated from the decay of the 1$^-$ 9.60 MeV state of ^{16}O into ^{12}C + α, a group of 9538 ± 1810 α particles with an energy of 1282 keV has been identified with a maximum error of ± 5 keV. This group is attributed to the parity non-conserving decay from the 2$^-$ 8.87 MeV state of ^{16}O into ^{12}C + α; the α-particle emission width for this decay has been determined to the Γ_α = (1.03 ± 0.28) × 10^{-10} eV. In a separate measurement the relative ^{16}N β decay branching ratio to the 9.60 and 8.87 MeV states in ^{16}O, which was necessary for the calculation of Γ_α, has been determined to be (9.98 ± 0.70) × 10^{-4}. (auth)

25555 β DECAY OF ^{12}B AND ^{12}N. McDonald, R.E.; Becker, J.A.; Chalmers, R.A. (Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304); Wilkinson, D.H. Phys. Rev. C 10: No. 1, 333-343 (July 1974).

The β decays of ^{12}B and ^{12}N to the first excited state of ^{12}C have been compared by detecting the β particles in 4π geometry and simultaneously collecting β–γ coincidences. All events were time sorted so that the ^{12}B, ^{12}N components of the β and β–γ coincidence spectra could be accurately extracted down to low values of the β-particle energy. For the ratio of the branching ratios ^{12}N/^{12}B we find 1.74 ± 0.08. This and other data are analyzed to extract the β-decay asymmetry [(ft)$^+$/(ft)$^-$]−1 = −0.013 ± 0.066. All existing data on asymmetry in Gamow-Teller β decay in even-A nuclei of the 1p shell are analyzed in the light of the work of Kubodera, Delorme, and Rho that, using appropriate many-body wave functions, relates the asymmetry to two fundamental second class current parameters ζ and λ. We find, at the 99% confidence limit, |ζ| < 4 × 10^{-3} MeV^{-1}; |λ| < 1.5 × 10^{-2}. In the model that ascribes all second class current effects to the G-parity-violating decay ω → πeν both as an exchange term (which enters into λ) and as a nucleon decay vertex renormalization term (which determines ζ and enters into λ), our results correspond to $\tau_{\omega\to\pi e\nu} > 5 \times 10^{-1}$ sec. This limit corresponds, using SU(3), to the expectation that the asymmetry in Σ → Aeν decay is less than 25%. (auth)

25556 ^{16}O(t,^{3}He)^{16}N REACTION AND THE LOW-LYING T = 1 LEVELS OF MASS 16. Flynn, E.R. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544); Garrett, J.D. Phys. Rev. C 10: No. 1, 409-411 (July 1974).

The ^{16}O(t,^{3}He) reaction at an incident energy of 23.5 MeV has been used to study the low-lying levels of ^{16}N. A comparison of these results with a previous study of the ^{16}O(^{3}He, t)^{16}F reaction permits assignment of J$^\pi$ = 0$^-$(1$^-$), 1$^-$(0$^-$), 2$^-$(3$^-$), and 3$^-$(2$^-$) for the ground, 0.197-, 0.424-, and 0.720-MeV states of ^{16}F, respectively. (auth)

25557 NEUTRONS FROM RADIATIVE PION CAPTURE IN CARBON, OXYGEN, AND CALCIUM. Lam, W.; Gotow, K.; MacDonald, B. (Physics Department, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061); Trower, W. P. Phys. Rev., C; 10: No. 1, 72-83(Jul 1974).

The energy spectra of neutrons between 2 and 28 MeV emitted following radiative pion capture in carbon, oxygen, and calcium fall off exponentially. An enhancement, however, is observed for neutron energies below 5 MeV in carbon and oxygen. Neutron yield peaks at n–γ angles of 180°, indicating a quasifree absorption mechanism in this process. (auth)

25558 MULTIPLET STRUCTURE OF HIGHLY EXCITED STATES IN ^{15}N AND ^{15}O. Purcell, J.E.; Meder, M.R. (Department of Physics, Georgia State University, Atlanta, Georgia 30303). Phys. Rev. C 10: No. 1, 89-98 (July 1974).

A series of calculations were performed which support the α-particle core excitation model as a possible explanation of the structure of certain highly excited states seen in ^{15}N and ^{15}O. The features of interest are the apparent compression of the core states and the multiplet structure. The compression is semiquantitatively accounted for by an enlargement of the single particle well due to the presence of the α particle. The standard core excitation model fails to account for the multiplet structure. An operator resulting from the nucleon–nucleon spin–orbit interaction is found to account successfully for the multiplet structure. In these calculations, the model of the core is that of a p$_{3/2}$ hole coupled to the states of ^{12}C. Two different models of the ^{12}C states are used and both give good results. (auth)

25559 STRUCTURE OF LOW-LYING NEGATIVE PARITY STATES OF ^{11}B AND ^{11}C. Meder, M.R.; Purcell, J.E. (Department of Physics, Georgia State University, Atlanta, Georgia 30303). Phys. Rev. C 10: No. 1, 84-88 (July 1974).

The low-lying negative parity states of ^{11}B and ^{11}C are interpreted as arising from a p$_{3/2}$ hole coupled to the ground state and first excited state of ^{12}C. The coupling interaction has been expanded in a series of spherical tensor operators including dipole and quadrupole terms. The parameters of the interaction are found by fitting to the experimental energies, moments, and transition rates of ^{11}B. The calculated β decay log(ft) value and most of the calculated static moments and transition rates are in excellent agreement with experiment. The exceptions are attributed to the limited bases used and to the fact that the free core and single particle operators are used; that is, no effective operators are used. An improvement in energies and in one transition rate is obtained by treating ^{12}C as a rotator and including a third core state. Possible improvements in the model are discussed. (auth)

25560 INVESTIGATION OF THE POLE GRAPH DOMINANCE IN THE REACTION ^{6}Li(p,pd)^{4}He BETWEEN 40 AND 50 MeV. Beveridge, J. L. (Univ. of Neuchatel, Switzerland); Corfu, R.; Egger, J. P.; Foroughi, F.; Piffaretti, J.; Rossel, J.; Schwarz, E.; Arvieux, J.; Durand, J. L.; Perrin, C. Helv. Phys. Acta; 47: No. 2, 211-219(1974).

Quasi-free proton-deuteron scattering in the ^{6}Li(p,pd)^{4}He reaction was investigated in a kinematically complete experiment. The pole graph was tested by measuring the incident energy dependence of the matrix element between 40 and 50 MeV keeping the invariants of the reaction constant and by applying the Treiman–Yang test at 50 MeV. (auth)

25561 CALCULATION OF THE GROUND STATE ENERGY OF THE 3-ALPHA PARTICLE SYSTEM (^{12}C NUCLEUS) USING THE FADDEJEV EQUATIONS. Jaisli, W. (Univ., Zurich). Helv. Phys. Acta; 47: No. 2, 189-210(1974). (In German).

The quantum mechanical three-body theory is applied to the three-alpha cluster model of ^{12}C to explain the experimental ground-state energy. A detailed comparison of the results with the work of other authors is presented. It turns out that the cluster model does not describe the physical reality of the ^{12}C ground-state adequately. (auth)

25562 DEUTERON PRODUCTION IN INTERACTION OF ELECTRONS WITH ATOMIC NUCLEI. Nagornyi, S. I.; Inopin, E. V. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 6, 992-999(Jun 1974). (In Russian).

The process of deuteron production in fast electron scattering by atomic nuclei was considered in the Born approximation by using the effective Hamiltonian of McVoy and Van Hove on the

basis of the single-particle models of the nucleus: the harmonic oscillator model and Fermi gas model. General expressions were obtained for differential cross sections. The ratio of cross sections for deuteron and proton knock-out was studied. It was established that the process of deuteron production is two orders less probable than that of proton production. Absorption of deuterons by nuclei was calculated. It was shown that the final-state interaction is of great importance for the process of deuteron production by electrons. (13 figures, 1 table) (auth)

25563 SHELL MODEL DESCRIPTION FOR THE REACTION OF KNOCKING-OUT PROTONS BY ELECTRONS FROM LIGHT NUCLEI. Mel'nik, Yu. P.; Gonchar, V. Yu.; Inopin, E. V. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 6, 965-975(Jun 1974). (In Russian).

The coincidence cross sections for the (e,e'p) reaction were calculated in the plane-wave impulse approximation for ^{6}Li and ^{12}C nuclei. The ^{12}C nucleus was considered within the framework of a simple shell model. To describe the ^{6}Li nucleus the model was used in which the nucleons of s and p shells are considered both independently and with the interaction between outer nucleons taken into account. The momentum distributions of the protons in s and p shells calculated with different wave functions for the bound proton were compared with experimental data on the absolute measurements for the (e,e'p) reaction on the nuclei mentioned. Within the framework of the models considered, satisfactory agreement with these data was obtained. (6 figures, 3 tables) (auth)

25564 POSITIVE PION PRODUCTION AT THRESHOLD ON A ^{10}B TARGET. Le Bornec, Y.; Tatischeff, B.; Bimbot, L.; Brissaud, I.; Garron, J. P.; Holmgren, H. D.; Reide, F.; Willis, N. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). Phys. Lett., B; 49: No. 5, 434-436(13 May 1974).

The angular distribution of low-energy positive pions ($E_\pi \sim$ 11 MeV) produced by 154 MeV protons on a ^{10}B target has been measured between 16.2 and 54.8° cm angles. Only pions corresponding to the ground state of ^{11}B were observed. The data have been compared with theoretical angular distributions calculated in the framework of the one-nucleon mechanism using the DWBA formalism. (auth)

25565 APPLICATION OF THE RESONATING GROUP METHOD TO THE SCATTERING OF LIGHT AND MEDIUM HEAVY NUCLEI. Friedrich, H. (Muenster Univ. (F.R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 224: No. 3, 537-556(27 May 1974).

A method is proposed for applying the resonating group method to the scattering of medium heavy nuclei. The RGM potentials are determined by directly unfolding the associated integral kernels of the generator coordinate method. A one channel RGM calculation is performed for the elastic scattering of two ^{16}O nuclei. The results show a series of resonances constituting an almost perfect rotational band, which seems to be responsible for the gross structure found experimentally in the excitation functions. (auth)

25566 COULOMB ENERGY SHIFTS OF THE GROUND STATES OF A = 18 AND A = 42 NUCLEI. Shlomo, S.; Bertsch, G. F. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Phys. Lett., B; 49: No. 5, 401-404(13 May 1974).

The theory of Coulomb displacement energies of the ground states of ^{18}Ne-^{18}O and ^{42}Ti-^{42}Ca is evaluated with a view to making bounds on the possible violation of charge symmetry in the strong interaction. The theoretical uncertainties are found to be of ~8%, and the discrepancies between theory and experiment are much larger than the possible charge-violating potential being sought. (auth)

25567 COULOMB EXCHANGE CONTRIBUTION IN NUCLEAR HARTREE-FOCK CALCULATIONS. Titin-Schnaider, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)); Quentin, P. (Niels Bohr Institutet, Copenhagen (Denmark)). Phys. Lett., B; 49: No. 5, 397-400(13 May 1974).

The validity of commonly used approximations for Coulomb exchange terms is checked by an exact calculation of the total Coulomb contribution to the Hartree-Fock field. The Skyrme SIII effective force has been chosen for the nuclear part of the interaction. Calculated nuclei range from ^{16}O to ^{56}Ni through deformed s-d shell nuclei. (auth)

25568 STRANGENESS ANALOGUE STATES AND THE SPECTRUM OF $^{12}_{\Lambda}$C. Huefner, J.; Lee, S. Y.; Weidenmueller, H. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)). Phys. Lett., B; 49: No. 5, 409-411(13 May 1974).

The spectrum of $^{12}_{\Lambda}$C is discussed in the frame of a shell-model. Recent experimental data on K^- capture in ^{12}C are interpreted. It is shown that the strangeness analogue state is not even an approximate eigenstate of the system. (auth)

25569 OPTICAL MODEL PARAMETER SEARCHES FOR ^{16}O + ^{11}B ELASTIC SCATTERING. Delic, G. (Technische Univ. Darmstadt (F.R. Germany). Inst. fuer Kernphysik). Phys. Lett., B; 49: No. 5, 412-414(13 May 1974).

The direct search with pattern search technique of Hooke and Jeeves has been programmed to search for heavy ion optical model parameters and the results of unconstrained searches using this method for ^{16}O + ^{11}B elastic scattering are presented. (auth)

25570 INVESTIGATION OF THE ^{16}O(^{7}Li,t)^{20}Ne AND ^{15}N(^{7}Li,t)^{19}F REACTIONS WITH MICROSCOPIC α-CLUSTER PLUS CORE WAVE FUNCTIONS. Kubo, K. I. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)); Nemoto, F. (Kyoto Univ. (Japan). Research Inst. for Fundamental Physics); Bando, H. (Fukui Univ. (Japan) Div. of Mathematical Physics). Nucl. Phys., A; 224: No. 3, 573-588(27 May 1974).

The excitation of weak-coupling "4p-Oh" and "4p-1h" states by the four-particle transfer reactions ^{16}O(^{7}Li,t)^{20}Ne and ^{15}N(^{7}Li,t)^{19}F is investigated with the finite-range DWBA treatment using the α reduced width amplitudes obtained by the generator coordinate method employed on extended Bloch-Brink type wave functions. In agreement with experiment, an enhancement of the cross section in the ^{15}N(^{7}Li,t)^{19}F transition over that in the ^{16}O(^{7}Li,t)^{20}Ne transition is found in the forward angle region where the direct process is expected to be dominant, although its magnitude is about 50-60% of that observed. (auth)

25571 CHARGE-CHANGING CROSS-SECTIONS, AND CHARGE-STATE DISTRIBUTIONS OF FEW-ELECTRON LIGHT IONS IN SOLID AND GASEOUS TARGETS. Debiak, T. W. Pittsburgh; Univ. of Pittsburgh (1973). 66p. University Microfilms Order No. 74-18,435.

Thesis. (Ph. D.).

Lithium-6 ions at 18.4×10^8 cm/sec and beryllium-9 ions at 17.4×10^8 cm/sec were produced as forward-angle recoils from the ^{10}B(d,^{6}Li)^{6}Li and ^{11}B(d,α)^{9}Be reactions in boron targets. Upper limits to the electron capture and loss cross sections of these ions were calculated by the analytical solution of the coupled set of differential equations which describes the approach to charge-state equilibrium of recoils from nuclear processes. The calculations are in agreement with previously reported results of a numerical integration method for systems consisting of three charge-states. The present method, however, makes it unnecessary to assume a primary charge-state distribution from a target of infinitesimal thickness. The primary charge-state distributions of the recoils from nuclear processes, as calculated using the analytical solution, are compared with those observed in the thinnest targets. The dependence of the ratio of equilibrium charge-state fractions of beryllium ions was determined as a function of velocity between 17.4×10^8 and 18.2×10^8 cm/sec. Comparison of the results of this experiment with results at lower velocities supports Betz's model of the density effect in solids. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 23510, 25294, 25303, 25543, 25550, 25567, 25583, 25609, 25612, 25621, 25623, and 25624.

25572 (AERE-PR/NP-20, pp 20-22) $0^+ \rightarrow 0^+$ SUPERALLOWED β DECAYS AND THEIR RELATION TO WEAK INTERACTION THEORY. Freeman, J. M. (Atomic Energy Research Establishment, Harwell, Eng.); Petty, R. J.; Draper, J. E.; Burcham, W. E.; Squier, G. T. A.; Ryder, J. S.; Hoath, S. Jan 1974.

25573 HIGH-SPIN STATE AT 3918 keV IN ^{26}Al. Price, H.G.; Butler, P.A.; James, A.N.; Nolan, P.J.; Sharpey-Schafer, J.F. (Oliver Lodge Laboratory, University of Liverpool, Liverpool, United Kingdom). Phys. Rev. C 10: No. 1, 415-417 (July 1974).

The level at 3918 keV in ^{26}Al has been populated with the ^{23}Na(α, n)^{26}Al reaction and shown to have a spin of 7^+ although a 5^+ possibility cannot be completely excluded. The level decays 100% to the 5^+ ground state and has an E2 strength of 6.7 $\pm$ 2.2 Weisskopf units if the 7^+ assignment is assumed. Recent calculations with the Glasgow shell model program using the interaction of Preedom and Wildenthal predict a 7^+ state at this excitation energy. (auth)

25574 INTERMEDIATE RESONANCES IN THE RANGE OF EXCITATION ENERGY FROM 13.706 TO 15.756 MeV IN ^{30}P THROUGH THE ^{28}Si(d, p)^{29}Si REACTION. Hsu, C.C.; Pai, T.P. (Department of Physics, National Tsing Hua University, Hsinchu, Taiwan, China); Tohei, T.; Morita, S. Phys. Rev. C 10: No. 1, 422-424 (July 1974).

10 intermediate resonances with their spins and parities were identified in this study. The average width is 160 $\pm$ 60 keV, which is

consistent with the value 153 keV predicted by Hsu's relationship. (auth)

25575 IS $^{32}S(^{16}O, ^{12}C)^{36}Ar$ α^* TRANSFER?. Charlton, L.A.; Robson, D. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. Lett. 32: No. 17, 946-950 (29 Apr 1974).

The differential cross section for $^{32}S(^{16}O, ^{12}C)^{36}Ar$ has been analyzed with the finite-range distorted-wave Born-approximation computer code MERCURY (which includes recoil effects exactly). The general features of the data were reproduced only by assuming that the α particle was transferred in an excited state. Good fits to the data were found by also including L-dependent absorption in the optical potentials. (auth)

25576 INTERACTION OF POSITIVE AND NEGATIVE PIONS WITH ^{27}Al AND ^{28}Si. Ashery, D.; Zaider, M.; Shamai, Y.; Cochavi, S.; Moinester, M.A.; Yavin, A.I.; Alster, J. (Department of Physics and Astronomy, Tel Aviv University, Ramat Aviv, Israel). Phys. Rev. Lett. 32: No. 17, 943-946 (29 Apr 1974).

The interaction of low-energy positive and negative pions with ^{27}Al and ^{28}Si was studied by the detection of γ radiation emitted from residual nuclei formed in the reaction. Large cross sections for the removal of "α" clusters were found for both nuclei and both pion charges. A large asymmetry is observed between the cross sections for the $(\pi^-, \pi^- p)$ and $(\pi^+, \pi^+ n)$ on ^{28}Si leading to mirror states in ^{27}Al and ^{27}Si. The ratio of π^+ to π^- cross sections for proton knockout is about a third of the value predicted by a simple impulse approximation. (auth)

25577 SPECTROSCOPY WITH HIGH SPIN SELECTIVE COMPOUND REACTIONS INDUCED BY HEAVY IONS. Klapdor, H. V.; Reiss, H.; Rosner, G.; Schrader, M. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)). Phys. Lett., B; 49: No. 5, 431-433(13 May 1974).

A spectroscopic method for selective excitation and quantitative analysis of high-spin states in sd-shell nuclei is presented and tested in several heavy-ion reactions. The hypothesis of a "superband" in ^{20}Ne is tested by means of the reaction $^{10}B(^{12}C,d)^{20}Ne$. (auth)

25578 INVESTIGATION OF THE $^{29}Si(n,\gamma)^{30}Si$ REACTION WITH NON-POLARIZED AND POLARIZED THERMAL NEUTRONS. Spits, A. M. J.; de Boer, J. (Stichting Reactor Centrum Nederland, Petten). Nucl. Phys., A; 224: No. 3, 517-536(27 May 1974).

The γ radiation following capture of nonpolarized as well as polarized thermal neutrons in ^{29}Si has been investigated. All but one of the 56 γ rays ascribed to the $^{29}Si(n,\gamma)$ reaction could be placed into a ^{30}Si decay scheme. The excitation energies of 21 bound states, three of which have not been reported previously, have been determined with 0.14-0.8 keV errors. The spin and parity of the E_x = 8.16 MeV level have been determined as 1^-. The thermal-neutron capture cross sections of ^{28}Si and ^{29}Si are 160 ± 18 mb and 101 ± 14 mb, respectively. The (n,γ) reduced primary transition probabilities are strongly correlated with the (d,p) spectroscopic factors for $1_{\frac{1}{2}}(d,p) = 1$ levels. A simple shell-model calculation supports the experimentally founded assumption that, in addition to the E_x = 8.16 MeV level, there are one or more other levels with $J^\pi = 1^-$ and with rather large relative $2s_{\frac{1}{2}}$ $2p_{\frac{1}{2}}$ strength. (auth)

25579 TEST OF NEW SHELL MODEL WAVE FUNCTIONS BY MEANS OF 166 MeV ALPHA PARTICLE INELASTIC SCATTERING. Bimbot, L.; Brissaud, I.; Le Bornec, Y.; Tatischeff, B.; Willis, N. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire); Soyeur, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Physique Theorique). Phys. Lett., B; 49: No. 5, 443-446(13 May 1974).

The nuclear wave functions for the first 2^+ levels of ^{24}Mg, ^{28}Si and ^{58}Ni obtained by diagonalizing an effective Hamiltonian in a large shell model basis are used to calculate 166 MeV α-particle inelastic scattering cross sections. The results are compared with experimental measurements. Good agreement is found for ^{24}Mg and ^{28}Si but the model wave function seems to be inadequate for describing ^{58}Ni. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 25543, 25550, 25557, 25566, 25567, 25579, 25609, 25612, 25621, 25623, and 25658.

25580 (AAEC/E-302) MEASUREMENT OF PARTIAL CAPTURE CROSS SECTIONS FOR NEUTRON ENERGIES ABOVE 10 keV. Broomhall, G. J.; Kenny, M. J.; Martin, P. W.; Bird, J. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1974. 20p. Dep. NTIS (U. S. Sales Only) $4.00.

A large NaI detector has been used to demonstrate the feasibility of measuring partial capture cross sections for neutron energies from 10 to 100 keV. The pulsed neutron source was a 3 MeV accelerator and the $^7Li(p,n)$ reaction with a time resolution of 3 to 4 ns and flight paths of 0.6 to 1.5 m. The experimental techniques are described and illustrated by results for high-energy transitions following capture in ^{48}Ti, ^{56}Fe, ^{58}Ni and ^{207}Pb. (auth)

25581 (CONF-740637-7) TRANSFER REACTION ON HEAVY NUCLEI (A ≥ 40). Kovar, D. G. (Argonne National Lab., Ill. (USA)). 1974. 23p. Dep. NTIS $4.25.

From international conference on reactions between complex nuclei; Nashville, Tennessee, USA (10 Jun 1974).

Recent experimental and theoretical work on heavy-ion-induced few-nucleon transfers and the possibilities of these reactions as probes of nuclear structure are reviewed. Some basic features of the dynamics of single-nucleon-transfer reactions are discussed first; these include the behavior of the cross section magnitude and the shapes of the angular distributions. The sensitivity to nuclear structure is then examined for single-nucleon transfers, two-nucleon transfers, and four-particle transfer. The reliable extraction of spectroscopic information by DWBA analysis of single-nucleon transfers and multinucleon transfers is considered. Finally, the assumption of a simple one-step mechanism is abandoned, and experimental evidence relating to inelastic two-step processes and sequential two-step transfers is presented. (21 figures, 55 references) (RWR)

25582 (KFK-1968) METHOD TO INVESTIGATE NEUTRON INELASTIC CROSS SECTION DATA BY ANALYZING FAST NANOSECOND DECAYING SPECTRA. Pieroni, N. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). May 1974. 101p. Dep. NTIS (US Sales Only) $8.25.

Thesis.

A method to test and improve neutron inelastic scattering cross section data for reactor materials was developed. It is based on the great sensitivity of fast nanosecond decay leakage spectra of small pulsed systems to the inelastic scattering process. By analyzing the decaying spectra in small energy intervals, quantitative changes in the inelastic cross section data can be introduced to provide agreement between calculation and measurement. In this manner adjusted data can be defined. The method required the use of a reliable spectrometric procedure to measure fast nanosecond time-dependent spectra and an appropriate time-dependent spectra computational procedure. An NE 213 liquid scintillator detector was used in the measurements. The Karlsruhe Monte-Carlo program KAMCCO was adapted for the calculations. The method was applied to the study of an iron and a natural uranium system. It was possible to define adjusted inelastic cross section data for iron and ^{238}U. The reliability of the information obtained by the present method was verified through independent experiments. (20 figures, 7 tables) (auth)

25583 (LUNP-7303) PRODUCTION OF ^{24}Na FROM TARGETS WITH 13 ≤ Z ≤ 29 . Jaerund, A.; Friberg, B.; Forkman, B. (Tekniska Hoegskolan, Lund (Sweden). Institutionen foer Kaernfysik; Lund Univ. (Sweden). Fysiska Institutionen). Mar 1973. 26p. Dep. NTIS (US Sales Only) $4.50.

The yields of the reactions nucleus$(\gamma,yp\ xn)^{24}Na$ were measured for eleven elements with 13 ≤ Z ≤ 29 at maximum bremsstrahlung energies 100 MeV ≤ $E_{\gamma\ max}$ ≤ 1000 MeV. An exponential decrease with increasing Z of the mean cross section calculated from the yield data was obtained. This Z dependence is consistent with cascade-evaporation calculations. (5 figures, 2 tables) (auth)

25584 (ORNL-TM-4638) COMPARISONS OF PREDICTIONS FROM TWO INTRANUCLEAR-CASCADE MODELS WITH MEASURED SECONDARY PROTON SPECTRA AT SEVERAL ANGLES FROM 62- AND 39-MeV PROTONS ON VARIOUS ELEMENTS. Bertini, H. W.; Harp, G. D.; Bertrand, F. E. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 29p. Dep. NTIS $4.50.

Detailed comparisons of correlated energy-angle proton spectra corresponding to continuum state transitions were made between experimental data and two versions—those of Brookhaven National Laboratory (BNL) and Oak Ridge National Laboratory (ORNL)—of the intranuclear-cascade model for 62- and 39-MeV protons incident on carbon, iron, and bismuth. These energies were selected because detailed experimental data are available and because the energy limit of validity of the intranuclear-cascade approach could be examined. The calculated spectra are in good agreement (≲30%) with the shapes and magnitudes

of the measured integral spectra for the 62-MeV reactions. However, the comparisons of the spectra at angles $\lesssim 20°$ and $> 90°$ are poor. There is a much greater discrepancy in the correlated energy–angle data from reactions at 39 MeV. The BNL version, which contains the greater physical detail, tends to reduce the discrepancies in the spectral shape at small and large angles between the experimental data and the simpler intranuclear-cascade version (ORNL). Examples of these discrepancies are a high estimated quasi-free peak at small angles and a small scattering intensity at back angles. The BNL version, however, reduces the particle yield for heavy targets so that the comparisons of the predicted absolute cross sections with the experimental data are often poor. The effects of reflection and refraction, which are included in the BNL version only, appear to be in the right direction to compensate for the discrepancies of the ORNL version; but some modification in the manner that this phenonenon is incorporated may be required to avoid the discrepancies in absolute cross sections. (10 figures) (auth)

25585 LIFETIME OF THE 2.755 keV $15/2^-$ STATE IN ^{43}Ca. Lieb, K. P.; Uhrmacher, M. (Koeln Univ. (F. R. Germany). Inst. fuer Kernphysik). Z. Phys.; 267: No. 5, 399-402 (May 1974). 2 figs.; 2 tabs.; 20 refs.

Using the recoil distance Doppler shift method, we measured the lifetime of the 2.755-keV $15/2^-$ state in ^{43}Ca populated in the reaction ^{28}Si(^{18}O,2pn) to be $\tau = 39 \pm 5$ ps. We also remeasured the lifetime of the 2.751-keV 4^+ state in ^{42}Ca excited in the reaction ^{28}Si(^{18}O,2p) to be $\tau = 3.8 \pm 0.4$ ps. Effective charges derived from E2 transition between $f_{7/2}^n$ high-spin states are discussed. (auth)

25586 INELASTIC ELECTRON SCATTERING AND THE STRUCTURE OF SHELL-MODEL NUCLEI: THE ^{40}Ca CASE. Federman, P. (CIEA del IPN, Departamento de Fisica, Apartado Postal 14-740, México 14, D.F.); Donnelly, T.W. Phys. Rev. C 10: No. 1, 12-18 (July 1974).

Inelastic electron scattering is shown to be a very powerful tool to study the structure of shell-model nuclei, since the form factors are very sensitive to small admixtures of different orbitals. For instance, in our ^{40}Ca case admixtures of only 1% $1p_{3/2}$ orbital in the pure $f_{7/2}$ orbital produce strong changes in the form factors. Thus, inelastic electron scattering will shed light on the question of "deformed states" in ^{40}Ca. Also, it is pointed out that "effective" multipole matrix elements can be extracted. In turn, those matrix elements can be used for structure analysis of shell-model nuclei by giving information on which admixtures should be included to reproduce them. (auth)

25587 LIFETIME LIMITS FOR THE ^{46}Ca 2_1^+ (1.35-MeV) AND 0_2^+ (2.42-MeV) STATES. Becker, J.A.; Bardin, T.T.; Fisher, T.R.; Watson, B.A. (Lockheed, Palo Alto Research Laboratory, Palo Alto, California 94304); Warburton, E.K. Phys. Rev. C 10: No. 1, 99-100 (July 1974).

Nuclear lifetime limits $\tau_m > 8$ psec and > 6.5 psec, were deduced for the ^{46}Ca excited states at $E_x = 1.347$ and 2.423 MeV, respectively. These values are compared with similar measurements in ^{42,44}Ca. (auth)

25588 LIFETIME MEASUREMENTS AND COLLECTIVE BEHAVIOR IN ^{49}V. Tabor, S.L.; Zurmühle, R.W. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 10: No. 1, 35-44 (July 1974)

Lifetimes of levels in ^{49}V have been measured using the Doppler-shift attention method. States were populated with the ^{46}Ti(α,p)^{49}V reaction at a beam energy of 10 MeV. Protons were detected near 180° relative to the beam and most Doppler shifts were measured between γ spectra accumulated at $\theta_\gamma = 53$ and 140°. Values or limits were obtained for the mean lifetimes of 25 levels in ^{49}V from 748 to 2812 keV in excitation energy. The positive parity levels appear to form two rotational bands with $K^\pi = 3/2^+$ and $1/2^+$. The first 2 MeV of the negative parity level scheme is reproduced rather well with calculations using the strong coupling model. This model also predicts the transition strengths reasonably well. These results suggest strong collective behavior in the states of both parities. (auth)

25589 NUCLEAR STRUCTURE OF ^{46}K: STUDIES WITH ^{45}Ca(d, $\alpha\gamma$)^{46}K AND DEUTERON-TRANSFER REACTIONS. Daehnick, W.W.; Orloff, J.H.; Canada, T.; Bhatia, T.S. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. C 10: No. 1, 136-149 (July 1974).

The reactions ^{45}Ca(d, α)^{46}K and ^{45}Ca(d, $\alpha\gamma$) were studied at $E_d = 17$ and 7 MeV, respectively. Angular distributions for the ^{45}Ca(d, α) reaction were obtained in 5° steps from $\theta_{lab} = 10°$ to $\theta_{lab} = 145°$. Data for $\theta \leq 60°$ were taken with a split-pole spectrograph with resolutions of 13-25 keV. Only the levels at 0, 0.587, 0.691, 0.886, 1.370, 1.738, and 1.941 MeV were seen significantly above background. Excitation functions for $16 \leq E_d \leq 17$ MeV at $\theta = 90$ and 100° showed energy dependent cross section variations of $\lesssim \pm 15\%$ for the ground state and 0.587 MeV level, larger ones for the 1.738 MeV state, and negligible variations for the 0.691, 0.886, and 1.941 MeV levels. The level energies listed were also deduced from the fast α-γ coincidence spectra which also served to set independent spin limits. A simultaneous microscopic distorted wave Born approximation analysis for the (d, α) data and the ^{45}Ca(p,^{3}He) and ^{48}Ca(p, t)^{46}Ca ($T = 4$) cross sections previously studied at $E_p = 42$ MeV was performed. Under the assumption that ^{48}Ca is doubly magic, theoretical and empirical wave functions for the six low-lying negative parity states of ^{46}K were deduced and used to derive empirical $(s_{1/2}f_{7/2})^2$, $(d_{3/2}f_{7/2})^2$, and $(s_{1/2}f_{7/2}, d_{3/2}f_{7/2})$ residual n-p interaction matrix elements. The ^{45}Ca(d, α) reaction at 17 MeV, as well as the ^{45}Ca(p,^{3}He) and the ^{48}Ca(p, t) transitions at $E_p = 42$ MeV show some features that cannot be explained by one-step direct two-nucleon transfer. The excitation of unnatural parity states in ^{48}Ca(p, t)^{46}Ca ($T = 4$) and the importance of $L > j-1$ transitions for the corresponding states in ^{46}K point to significant two-step contributions. Similarly, the triplet ($\Delta S = 1$), ($\Delta T = 0$) transfers in (p,^{3}He) are underpredicted with respect to singlet transfers. (auth)

25590 NEGATIVE-PARITY BAND IN ^{49}V. Haas, B.; Taras, P. (Laboratoire de Physique Nucléaire, Université de Montréal, Montréal, Canada). Phys. Rev. Lett. 33: No. 2, 105-108 (8 July 1974).

The electromagnetic decays of levels in ^{49}V have been studied via the reaction ^{34}S(^{16}O, pn)^{49}V at incident ion energies of 30-36 MeV. Spins, parities, and branching and mixing ratios were obtained from angular distributions, excitation function, γ-γ, and n-γ coincidence measurements. Six, and possibly seven, members of a very pure rotational negative-parity band were identified. This band is based on a 1^- low-lying core excited state with probable configuration $(\pi d_{3/2})^{-1}$ $(\pi f_{7/2})^4$ $(\nu f_{7/2})^5$. (auth)

25591 LIFETIMES AND g FACTORS IN DECOUPLED BANDS. Nakai, K.; Proetel, D.; Diamond, R.M.; Stephens, F.S. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 32: No. 24, 1380-1383 (17 June 1974).

Lifetime and g-factor measurements on the $I = j+2$ state in the decoupled bands of ^{157}Er and ^{159}Er are shown to be in agreement with those expected from the rotation-aligned coupling scheme. Such measurements provide a general way to differentiate this coupling scheme from the better-known weak- and strong-coupling schemes. (auth)

25592 EVIDENCE FOR QUADRUPOLE PAIRING IN ^{56}Ni. Fuchs, H.; Grabisch, K.; Hilscher, D.; Jahnke, U.; Kluge, H.; Masterson, T. G.; Morgenstern, H. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F.R. Germany). Bereich Kern- und Strahlenphysik). Phys. Lett., B; 49: No. 5, 447-450 (13 May 1974).

Thirteen new levels in ^{56}Ni and nine new J^π assignments were obtained from the investigation of the reaction ^{54}Fe(τ,n)^{56}Ni at a ^{3}He energy of 13.0 MeV. The new detailed knowledge of the level scheme of ^{56}Ni obtained by this investigation qualitatively agrees with and gives evidence for quadrupole pairing in ^{56}Ni. The two-proton transition strengths support this interpretation. (auth)

25593 ^{40}Ca(d,α)^{38}K AND ISOSPIN. Smith, H. V. Jr. (Rice Univ., Houston, Tex. (USA). Bonner Nuclear Labs.). Nucl. Phys., A; 224: No. 3, 561-572 (27 May 1974).

The ^{40}Ca(d,$\alpha_{0,1,2,4}$)^{38}K reactions are investigated for $E_d = 4.00$-4.61 MeV. The α_1 and α_4 transitions are isospin forbidden. The resonant-like structures observed in the α_0, α_1, α_2, and α_4 transitions are consistent with Ericson theory. In addition one can fit a portion of the α_1 data with a few interfering Breit-Wigner resonances. The level parameters for the corresponding ^{42}Sc levels are given. (auth)

25594 THE ^{40}Ar(τ,n)^{42}Ca REACTION. Petersen, J. F.; Parkinson, W. C. (Michigan Univ., Ann Arbor (USA). Cyclotron Lab.). Phys. Lett., B; 49: No. 5, 425-427 (13 May 1974).

The results of an investigation of the ^{40}Ar(τ,n)^{42}Ca reaction at 18.65 MeV incident energy are reported. The weakness of the transition to the 1.84 MeV 0^+ level is in disagreement with 4p-2h descriptions of this state. (auth)

25595 TOTAL CROSS SECTIONS FOR SOME (α,n) AND (α,p) REACTIONS IN MEDIUM-WEIGHT NUCLEI. Vlieks, A. E.; Morgan, J. F.; Blatt, S. L. (Ohio State Univ., Columbus (USA). Dept. of Physics). Nucl. Phys., A; 224: No. 3, 492-502 (27 May 1974).

Total cross sections have been measured for the ^{45}Sc(α,n), ^{46}Ti(α,n), ^{50}Cr(α,n), ^{51}V(α,n), ^{54}Fe(α,n) and ^{58}Ni(α,p) reactions, and stellar reaction rates have been calculated from them. These have been compared to recent theoretical calculations which used compound nuclear theory. The calculated values are generally higher than the experimental values by factors ranging from 2 to 10. (auth)

25596 NUCLEAR RESONANCE FLUORESCENCE IN ^{55}Mn. Justice, D. A. Notre Dame, IN; Univ. of Notre Dame (1974). 156p. University Microfilms Order No. 74-17,427.

Thesis (Ph. D.).

The level structure of ^{55}Mn was investigated by detecting resonantly scattered thin-target bremsstrahlung with a 50-cm^3 Ge(Li) detector. Widths for the states at 2251 keV and 3004 keV were determined to be $19.2^{+3.3}_{-3.3}$ MeV and $(14.6^{+3.3}_{-3.3})$/g MeV. A state at 4004.4 ± 2.3 keV was observed to decay only to the ground state and to have a width of $(36.0^{+8.2}_{-8.2})$/gW MeV. A state at 5535.8 ± 3.8 keV was observed to decay both to the ground state and to a state at 1289 ± 6 keV. The full width was determined to be (1096^{+336}_{-336})/gW MeV if the spin is $^3/_2$, or (1181^{+1181}_{-591})/gW MeV if the spin is $^5/_2$. The state at 2199 keV was observed to decay to the ground state, the state at 126 keV, and the state at 984 keV. The observed branching ratios were 0.61 ± 0.08, 0.03 ± 0.02, and 0.36 ± 0.11. The state at 2366 keV was observed to decay to the ground state and to the state at 126 keV. The branching ratios were 0.31 ± 0.03 and 0.69 ± 0.05. Additional states were observed at 5510 ± 5 keV and 5477 ± 5 keV. Additional gamma rays of energies 5379 ± 5 keV, 5320 ± 5 keV, 5260 ± 5 keV, 5250 ± 5 keV, 5238 ± 5 keV, 5193 ± 5 keV, 5135 ± 5 keV, 5056 ± 5 keV, and 5015 ± 5 keV were observed. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 24087, 25286, 25294, 25303, 25580, 25581, 25583, 25609, 25612, 25614, 25621, 25652, and 25658.

25597 (COO-3246-14, pp 10-22) ANGULAR CORRELATION STUDIES IN THE DECAY OF ^{75}Se. Jul 1974.

In research in nuclear chemistry.

25598 (COO-3246-14, pp 24-35) ANGULAR CORRELATION OF THE 53-13 keV CASCADE IN ^{73}Ge: POTENTIAL FOR HIGH RESOLUTION HYPERFINE INTERACTION STUDIES. Jul 1974.

In research in nuclear chemistry.

25599 (IPNO-PhN-73-07) STUDY OF THE (p,α) REACTION ON ^{93}Nb AND ^{89}Y. Vergnes, M.; Rotbard, G.; Kalifa, J.; Berrier-Ronsin, G. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). 1973. 26p. Dep. NTIS (U. S. Sales Only) $4.50.

The (p,α) reaction has been studied at 15.2 MeV on ^{93}Nb and ^{89}Y and analyzed using D.W.B.A. and cluster form factors. The reaction is a direct triton pick-up and compound-nucleus formation is negligible. In the first case the transferred neutrons are the two extra N = 50 shell neutrons, and the reaction behaves like a proton pick-up. Several positive-parity states of ^{90}Zr are populated by $g_{9/2}$ transfers with strengths in good agreement with a simple model; new levels are excited corresponding to $p_{1/2}$ and $f_{5/2}$ proton holes. In the second case the two neutrons are picked in the filled N = 50 shell; states corresponding to proton and neutron configurations in ^{86}Sr are excited with comparable strengths, and it is more difficult to get unambiguous spectroscopic information. The shapes of the angular distributions are well reproduced, however, and tentative spins and parities can be proposed for several states. (auth)

25600 (JINR-P1-7956) PROPERTIES OF LIGHT TRANSITION RADIATION OF 660 MeV PROTON (γ = 1.7) INCLINED INCIDENCE ON A THICK NICKEL PLATE. II. Zrelov, V. P.; Pavlovich, P.; Ruzhichka, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 32p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

The basic properties of transition radiation in the visible fraction of the spectrum were calculated for 660-MeV protons (γ = 1.7) obliquely incident on a thick nickel plate in vacuum. The angular distributions of the summary radiation (i.e., the sums of irradiations of various polarizations) both "forward" and "backward" for different azimuthal planes are presented in tables and diagrams for different particle inclination angles to the separation border. The examples of angular distributions of radiations having various polarizations (at the inclination angle of $\psi = 45°$) show that they differ considerably. The spectra of summary radiation are of monotonous character. The calculations have shown that in a relativistic case the "forward" radiation is concentrated near the direction of particle motion and "backward" radiation moves in an opposite direction with respect to that of particle inclination. The dependence of the total yield of "forward" and "backward" transition radiations upon the particle inclination angle ψ is $\approx \cos^2\psi$. (auth)

25601 LIFETIME OF ^{82}Kr AND ^{105}Rh NUCLEAR LEVELS. Begzhanov, R. B.; Gladyshev, D. A.; Azimov, K. Sh.; Narzikulov, M. Dokl. Akad. Nauk Uzb. SSR; No. 8, 19-20(1973). (In Russian).

Fifteen series of measurements on ^{82}Kr indicated that τ (2648 keV) = 250 ± 15 nsec, which is not inconsistent with published data. The probability of E1 transitions was calculated from the data. Data for ^{105}Rh indicated τ (469 keV) = 98 ± 13 nsec and τ (724 and 806 keV) = 27 ± 8 nsec. (1 figure) (TTT)

25602 ARE NUCLEI WITH N ~ 43 DEFORMED? Baba, C. V. K. (Bhabha Atomic Research Centre, Bombay); Bharathi, S. M.; Lal, B. Pramana; 2: No. 5, 239-242(May 1974).

The level schemes of ^{73}Se and ^{79}Kr were established through gamma-ray and conversion-electron spectroscopy following ^{73}As (p, n γ$^-$e) and ^{79}Br (p,nγe$^-$) reactions. The data on these nuclei and the nuclei in the neighborhood of this mass region are discussed, and evidence is presented to show that the nuclei with N ~ 43 are deformed. (1 figure) (auth)

25603 ONE-PROTON TRANSFER REACTIONS INDUCED BY ^{16}O AND ^{12}C ON ^{64}Ni. Cunsolo, A.; Lemaire, M.C.; Mermaz, M.C.; Sztark, H. (Department de Physique Nucleaire, CEN Saclay, BP-2, 91190 Gif-sur-Yvette, France); Low, K.S.; Tamura, T. Phys. Rev. C 10: No. 1, 180-186 (July 1974).

The (^{16}O, ^{15}N) and (^{12}C, ^{11}B) reactions on ^{64}Ni target have been investigated using 56 MeV ^{16}O and 48 MeV ^{12}C beams. Angular distributions were obtained for the first five excited states of ^{65}Cu. No-recoil distorted-wave Born-approximation (DWBA) analyses were made and striking anomalies were found especially for the (^{16}O, ^{15}N) reaction leading to the $j_<$ states. These anomalies were then shown to disappear if exact finite-range DWBA analyses were made, which gave reasonable absolute spectroscopic coefficients in close agreement with those obtained in light ion reactions. (auth)

25604 INTERFERENCE BETWEEN COULOMB AND NUCLEAR EXCITATION IN THE INELASTIC SCATTERING OF ^{22}Ne FROM ^{88}Sr. Gross, E. E.; Bingham, H. G.; Halbert, M. L.; Hensley, D. C.; Saltmarsh, M. J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev., C; 10: No. 1, 45-49(Jul 1974).

We have measured the excitation function at $\theta_{lab} = 175°$ for the excitation of the first 2$^+$ state in ^{88}Sr* by inelastic scattering of ^{22}Ne. At the same time we obtained similar data for the excitation of the first 2$^+$ state of the beam particle itself. The measurements span the energy range 49-65 MeV containing the region of the Coulomb-nuclear interference. In terms of Rutherford trajectories, the ^{22}Ne* interference minimum is located at a separation ~0.2 fm greater than for ^{88}Sr*. An optical potential was obtained by a fit to elastic scattering data consisting of an excitation function at $\theta_{lab} = 175°$ and an angular distribution at 65.4 MeV lab. A collective model distorted-wave Born-approximation calculation with this potential can account for the ^{88}Sr* data but fails to describe the shape of the ^{22}Ne* excitation function. (auth)

25605 MULTI-NUCLEON TRANSFER NEAR THE COULOMB BARRIER INDUCED BY ^{32}S AND ^{34}S. Wegmann, H.; Kutschera, W.; Morinaga, H. (Technische Univ. Muenchen, Garching (F.R. Germany). Physik-Dept.). Phys. Lett., B; 49: No. 5, 437-439 (13 May 1974).

Neutron excess targets of ^{76}Ge, ^{92,94,96}Zr and ^{100}Mo have been bombarded with ^{32}S and ^{34}S at beam energies around the Coulomb barrier. Multi-nucleon transfer reactions involving 3p, 4p, 3pn, 4pn (projectile target) and 3n, 4n, 6n (target projectile) have been observed by measuring the corresponding back-scattered radioactive products like ^{29}Al, ^{28}Mg, ^{28}Al, ^{27}Mg, ^{37}S and ^{36}S. In some cases excitation functions and angular distributions have been measured. (auth)

25606 DECAY OF 22.1 MIN ^{83g}Se AND 69.2 SEC ^{83m}Se TO THE LEVELS OF ^{83}Br. Kracikova, T. I. (Charles Univ., Prague); Prochazka, I.; Frana, J.; Fiser, M.; Jursik, J.; Mastalka, A. Czech. J. Phys.; 24: No. 8, 852-877(1974).

The decay of ^{83}Se isomers was studied by using Ge(Li) detectors and a multiparameter analyzer system. In the case of ^{83g}Se decay, it was possible to observe coincidences in Ge(Li)-Ge(Li) configuration. A total of 90 γ rays were assigned to the decay of ^{83g}Se, and 25, to that of ^{83m}Se. The half-lives of ^{83g}Se and ^{83m}Se were found to be 22.1 ± 0.1 min and 69.2 ± 0.6 sec, respectively. Excited states of ^{83}Br were observed at 356.74, 799.2, 866.9, 988.1, 1030.8, 1053.9, 1092.1, 1352.7, 1420.9, 1439.0, 1660.4, 1701.5, 1804.7, 1810.4, 1915.6, 2051.9, 2058.7, 2398.2, 2647.2, 2694.3, 2738.3, 2777.5, 2946.7, and 3137.8 keV. The log-ft values for the branching to the excited levels of ^{83}Br were established, and spin-parity assignments for these levels were deduced. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 25303, 25599, 25601, 25605, 25630, 25631, 25633, and 25667.

25607 (AERE-PR/NP-20, pp 33-34) $^{93}Nb(n,\gamma)^{94}Nb$ REACTION: SPIN ASSIGNMENTS FOR RESONANCES IN ^{93}Nb. Thomas, B. W. (Atomic Energy Research Establishment, Harwell, Eng.); Haste, T. J. Jan 1974.

25608 (BNL-18973) 24 keV NEUTRON CAPTURE IN Nb. Rimawi, K.; Chrien, R. E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 3p. (CONF-740920-6). Dep. NTIS $4.00.

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

γ Rays resulting from 24-keV neutron capture by niobium were observed to confirm previously reported correlations from resonance capture at lower energies. The correlation coefficient with (d,p) stripping widths is about 0.5. (2 figures, 1 table) (auth)

25609 (BNL-18975) ENHANCED TRANSITIONS IN THE (n,γ) REACTION TO COLLECTIVE 3^- STATES IN NUCLEI NEAR CLOSED NEUTRON SHELLS. Kane, W. R. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 5p. (CONF-740920-4). Dep. NTIS $4.00.

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

Exceptionally strong primary transitions occur in the (n,γ) reaction to collective octupole states in even-even nuclei near closed neutron shells. The possible relevance of this effect to direct capture and doorway states in these nuclei is discussed. (2 figures) (auth)

25610 (BNL-18977) AVERAGE P-WAVE RESONANCE CAPTURE SPECTRA FROM ISOTOPES OF MOLYBDENUM. Rimawi, K.; Chrien, R. E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 4p. (CONF-740920-7). Dep. NTIS $4.00.

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

The 24-keV Fe-filtered beam was used to study p-wave capture on even Mo targets. The capture γ-ray spectra show pronounced correlations with final-state spectroscopic factors. The valence model is only of limited success in accounting for these correlations. (5 figures) (auth)

25611 (IAEA-R-596-F) FAST NEUTRON CROSS SECTIONS. Final Report, 1 April 1968-31 May 1972. Csikai, J. (International Atomic Energy Agency, Vienna (Austria)). Jul 1972. vp. (In English and Russian). INIS.

With neutrons from (d,t) and (d,d) reactions, and from Po-Be and Pu-Be sources, detected by stilbene and anthracene scintillators, ^{6}Li I (Eu) crystal and foil threshold detectors, the total neutron cross sections of thirty elements were measured. In a search for a systematic variation of total cross section values with isotope mass it was found that the deviations from a smooth mass-number dependence can be attributed to odd-even or N-Z effects. For light nuclei a correlation between the nuclear radius parameter and the average binding energy per nucleon was found. For medium and heavy nuclei an empirical expression to describe the total cross section surface as a function of mass number and neutron energy was developed. The (n,2n) cross sections of some fissionable isotopes were investigated. For $^{238}U(n,2n)^{237}U$ reaction with 14.4 MeV neutrons a cross section of 528 ± 58 mb was determined. Inelastic scattering cross sections for ^{113}In (66 ± 5 mb for 14.7 MeV neutrons, 260 ± 25 mb for 2.8 MeV neutrons) and ^{103}Rh (289 ± 25 mb at 14.7 MeV) were measured. Average activation cross sections for a number of elements were determined using Pu-Be and Po-Be neutron sources. (INIS)

25612 (LA-5662-MS) FOURTEEN-MeV, NEUTRON-INDUCED GAMMA-RAY PRODUCTION CROSS SECTIONS. Drake, D. M.; Arthur, E. D.; Silbert, M. G. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 13p. Dep. NTIS $4.00.

A pulsed 14.2-MeV neutron source and NaI(Tl) gamma-ray spectrometer were used to measure gamma-ray production cross sections for carbon, magnesium, aluminum, chromium, iron, nickel, copper, molybdenum, niobium, tantalum, platinum, ^{235}U, and ^{239}Pu. (18 figures, 2 tables) (auth)

25613 (NP-20123) RESEARCH ACTIVITY, 1973. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Fysik; Goeteborg Univ. (Sweden)). 1973. 80p. Dep. NTIS (US Sales Only) $7.00.

Research at Chalmers Technical University and Gothenberg University is reported in a series of one-page summaries with references. Work in the following areas is included: nuclear structure, atomic structure, electron structure of solids, ion physics, transport properties and structure of condensed matter, and metal physics and crystal studies. (RWR)

25614 (NRCN-346) MEASUREMENT OF ABSOLUTE WIDTHS OF NUCLEAR QUADRUPLE TRANSITIONS IN THE 4 TO 9 MeV RANGE. Shahal, O. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; Weizmann Inst. of Science, Rehovoth (Israel)). Aug 1973. 55p. (In Hebrew). INIS. Thesis.

The absolute radiative widths of 5 M2 and 4 E2 transitions, with energies between 4 and 8 MeV from high energy (6-8 MeV) levels in nuclei with A > 40 were measured. The levels were excited through the (γ,γ′) reaction, the γ-beam being obtained by thermal neutron capture on iron, titanium and copper. The spins of the resonance levels and the M2/E1 and E2/M1 mixing ratios were determined by angular distribution measurements. A compton polarimeter was used to determine the character (M1 or E1) of the elastically scattered radiation. Self-absorption, temperature effect, branching ratio and scattering cross section measurements were also performed, in order to determine the total and partial radiative widths of the resonance levels, M2 transitions of the form $1^- \rightarrow 2^+$ were found in even-even nuclei: ^{74}Ge, ^{112}Cd, ^{184}W, ^{100}Mo where 1^-, 2^+ are the spin and parity of the resonance level, and the low lying level populated by the particular transition, respectively. The M2 radiative widths were found to be between 40 and 200 μeV, corresponding to 0.007-0.89 Weisskoff units (W.U.). The E2 transitions were found in ^{126}Te, ^{141}Pr, ^{205}Tl and were between 150 and 1600 μeV, corresponding to $(1\text{-}3) \times 10^{-4}$ W.U. The M2 radiative widths are first experimental results for high energy transitions in A > 40 nuclei, their intensity is larger by about two orders of magnitude (in W.U.) than the E2 transitions. The E2 transitions strengths were of about the same order of magnitude as those found in (n,γ) reactions. (auth)

25615 (UCID-15439) GAMMA-RAY ENERGIES AND INTENSITIES. Gunnink, R.; Niday, J. B.; Anderson, R. P.; Meyer, R. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jan 1969. 81p. Dep. NTIS $7.25.

The energies and intensities of over 1100 gamma rays arising from some 120 prominent fission and activation product nuclides were measured (usually within ±0.1 keV). This preliminary report contains the resultant library of data routinely used in computer analysis of Ge(Li) spectra. (1 figure, 3 tables) (auth)

25616 (UJF-3303.F) INVESTIGATION OF THE $^{143}Nd(n,\alpha)^{140}Ce$ REACTION INDUCED BY THERMAL NEUTRONS. Kvitek, J.; Kosina, Z.; Popov, Yu. P. (Ustav Jaderne Fyziky, Rez (Czechoslovakia)). May 1974. 8p. Dep. NTIS (US Sales Only) $4.00.

The energy spectrum of α particles from thermal-neutron capture in ^{143}Nd was studied. Effective cross sections are given. The possible contribution of the $^{143}Nd(n,\gamma\alpha)$ reaction is discussed. (auth)

25617 NUCLEAR STRUCTURE OF THE HEAVY N = 82 ISOTONES: ^{144}Sm AND ^{146}Gd. Waroquier, M.; Heyde, K. (Ghent Rijksuniversiteit (Belgium). Instituut voor Kernwetenschappen). Z. Phys.; 268: No. 1, 11-18(May 1974).

4 figs.; 3 tabs.; 23 refs.

For single-closed shell nuclei with a large number of extra-protons, outside the Z = 50, N = 82 double-closed shell nucleus, a standard shell-model calculation yields dimensions of the Hamiltonian matrices beyond the scope of present computer technology. A quasi-particle (QP) calculation however, is able to describe the most important proton excitations in a much restricted configuration space. Extended BCS + TDA calculations are performed on the single-closed shell ^{144}Sm and ^{146}Gd nuclei with a Gaussian force as effective two-body interaction. The influence of the nonconservation of the exact number of extra-protons in the BCS-approach is studied by performing a projection onto the states with an exact number of extra-protons (BCS + P). (auth)

25618 NEUTRON INELASTIC SCATTERING FROM ^{91}Zr. Glickstein, S.S.; Tessler, G. (Bettis Atomic Power Laboratory, West Mifflin, Pennsylvania 15122). Phys. Rev. C 10: No. 1, 173-179 (July 1974).

γ-ray production cross sections produced via the $^{91}Zr(n,n'\gamma)$ reaction have been measured up to 6.19-MeV neutron energy at an angle of 55° to the incident neutron beam. Neutrons were produced from solid tritium and gaseous deuterium targets using the 3-MeV Bettis Van de Graff accelerator. The γ rays observed at energies of 652, 660, 713, 726, 792, 796, 1151, 1204.7, 1466.4, 1882.2, 2042.5, 2131.4, 2169.7, 2190.1, 2200.7, and 2367 keV were dectected with a 55-cm^3 Ge(Li) detector (3-keV resolution) placed inside a NaI annulus to suppress Compton events. The data have been corrected for multiple scattering and neutron flux attention in the sample. Angular distributions have been calculated and used to obtain the total γ-ray production cross section. The data are in good agreement with the results of Hauser-Feshbach calculations corrected for width fluctuations. (auth)

25619 ELECTROMAGNETIC PROPERTIES OF LOW-LYING LEVELS OF ^{129}Xe. Marest, G.; Haroutunian, R.; Berkes, I.; Meyer, M. (Institut de Physique Nucléaire, Université Claude Bernard Lyon-1 and IN2 P3, 43, Bd du 11 Novembre 1918-69621 Villeurbanne, France); Rots, M.; De Raedt, J.; Van de Voorde, H.; Oonis, H.; Coussement, R. Phys. Rev. C 10: No. 1, 402-405 (July 1974).

Unperturbed and perturbed angular correlation and conversion electron measurements have been performed to obtain spectroscopic information on the low-lying levels of ^{129}Xe fed by the decay of ^{129}Cs. We established I^{π}(318 keV) = 3/2$^+$, I^{π}(411 keV) = 1/2$^+$, I^{π}(589 keV) = 3/2$^+$, δ(39.6 keV) = $-(2.6 \pm 0.5) \times 10^{-2}$, δ(177 keV) = 0.44 × 0.13, δ(372 keV) = +0.97 ± 0.09, μ(39.6 keV) = +(0.88 ± 0.26) μ_N. B(M1) and B(E2) values are derived from above data and earlier lifetime determinations. A weak-coupling calculation is presented to explain experimental data. (auth)

25620 FAST HELIUM NUCLEI IN INTERACTIONS INDUCED BY VERY HEAVY NUCLEI. Jakobsson, B.; Kullberg, R.; Otterlund, I. (Lund Univ. (Sweden). Fysiska Institutionen). Z. Phys.; 268: No. 1, 1-9(May 1974).

7 figs.; 4 tabs.; 35 refs.

Fast helium nuclei emitted in interactions between heavy cosmic ray nuclei ($12 \leq Z \leq 26$) and photoemulsion nuclei at energies >1 GeV/nucleon have been studied. Comparisons with interactions where the incident particles are protons, pions or light nuclei reveal some characteristic features of nucleus-nucleus interactions. The frequency of fast target helium nuclei is much larger and the high energy tail of the energy spectrum of these helium nuclei is more pronounced in nucleus-nucleus interactions than in proton-nucleus and pion-nucleus interactions. The number of helium nuclei emitted depends on the size and disintegration of the interacting nuclei. In order to explain our experimental data several possible production mechanisms have to be considered. Some characteristics of the emission of multiply-charged projectile fragments have also been studied. (auth)

25621 ACCURATE ELASTIC SCATTERING CROSS SECTIONS FOR 17-MeV DEUTERONS. Childs, J.D.; Daehnick, W.W.; Spisak, M.J. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. C 10: No. 1, 217-230 (July 1974).

Angular distributions for 17.0-MeV (d, d) scattering on 23 isotopically pure targets (^{27}Al, ^{48}Ca, ^{51}V, ^{52}Cr, ^{54}Fe, ^{56}Fe, ^{59}Co, ^{58}Ni, ^{62}Ni, ^{64}Ni, ^{68}Zn, ^{89}Y, ^{93}Nb, ^{100}Mo, ^{105}Pd, ^{112}Cd, ^{115}In, ^{112}Sn, ^{120}Sn, ^{124}Sn, ^{208}Pb, ^{209}Bi, ^{232}Th) have been measured from $\theta_{lab} \leq 10$ to 165° in 5° steps. Relative experimental errors are always less than 2% and absolute scale errors range from 2 to 5%. Optical model searches have been performed on all angular distributions. Good fits were obtained (with four free parameters) for three values of the real radius parameter r_0 = 1.0, 1.1, and 1.2 fm using starting values of $V_0 \simeq 100$ MeV. The best fit parameters are presented for these searches, as well as for the best over-all nine-parameter fits. The data show some preference for parameter values close to r_0 = 1.1 fm (with a $\simeq$0.82) for all targets heavier than ^{48}Ca, although very acceptable fits are also obtained for all three sets with restricted parameters. The searches with nine free parameters resulted in overly perfect fits ($\chi^2 \lesssim 1$) indicative of considerable ambiguity for so large a parameter space. Preliminary global fits to our 17-MeV data yielded a formula for generating usable optical model parameters for other near-spherical nuclei of mass A > 48. (auth)

25622 FAILURE OF THE ALLOWED ASSUMPTION IN THE ϵ/β^+ DECAYS OF ^{145}Gd AND ^{143}Sm-EXPERIMENTAL EVIDENCE FOR INTERFERENCE EFFECTS IN NUCLEAR β DECAY. Firestone, R.B.; Warner, R.A.; McHarris, W.C. (Department of Chemistry, Cyclotron Laboratory, and Department of Physics, Michigan State University, East Lansing, Michigan 48823); Kelly, W.H. Phys. Rev. Lett. 33: No. 1, 30-33 (1 July 1974).

Anomalous ϵ/β^+ decay branching ratios for "hindered allowed" transitions (measured by γ^s-γ and x-γ coincidence techniques) have been found in ^{145}Gd → ^{145}Eu(808.5-keV state) and ^{143}Sm → ^{143}Pm(1173.2-keV state). These ratios exceed theoretical predictions by factors of 24 and 5, respectively. Thirteen additional ratios from these nuclei and ^{143}Eu agree with the predictions. This is the first conclusive evidence of the failure of the allowed assumption in nuclear β decay and of the presence of interference effects. (auth)

25623 SYSTEMATIC PSEUDOMAGNETIC MEASUREMENTS OF THE SPIN-DEPENDENT SCATTERING LENGTH OF SLOW NEUTRONS WITH ATOMIC NUCLEI. Roubeau, P.; Abragam, A.; Bacchella, G.L.; Glättli, H.; Malinovski, A.; Meriel, P.; Piesvaux, J.; Pinot, M. (Service de Physique du solide et de Résonance Magnétique, Centre d'Etudes Nucléaires de Saclay, 91190 Gif-sur-Yvette, France). Phys. Rev. Lett. 33: No. 2, 102-104 (8 July 1974).

The magnitude and the sign of spin-dependent scattering lengths of slow neutrons by nuclei of Li^7, Al^{27}, Sc^{45}, Zr^{91}, Nb^{93}, La^{139}, and Ta^{181} have been determined by measuring the dependence of the precession angle of the neutron spins on the nuclear polarization of the scattering target. (auth)

25624 EXTENDED TABLE OF ANGULAR-DISTRIBUTION COEFFICIENTS FOR (GAMMA, PARTICLE) AND (PARTICLE, GAMMA) REACTIONS. Maute, R. E.; D'Amato, D. P.; Blatt, S. L. (Ohio State Univ., Columbus). At. Data Nucl. Data Tables; 13: No. 6, 499-624 (Jun 1974).

Presented here is a tabulation of angular-distribution coefficients for photonuclear and radiative-capture reactions which extends the work of Carr and Baglin by listing cases involving M1 and E2 radiation not covered by the previous authors. In conjunction with the Carr and Baglin tabulation, the present work provides numerical values for reactions involving target and residual spins $\leq 5/2$, positive-parity particles of spin 0, 1/2, and 1, and radiation multipolarities through E2. Notation is identical to the earlier tabulation. Cross references are given. (auth)

25625 COUPLED-CHANNEL ANALYSIS OF THE 4.71 MeV $d_{5/2}$ ANALOGUE RESONANCE IN THE ^{90}Zr(p,p$_0$)^{90}Zr REACTION. Schrils, R. (Kentucky Univ., Lexington (USA). Dept. of Physics and Astronomy); Scott, H. L. (Georgia Univ., Athens (USA)). Nucl. Phys., A; 224: No. 3, 557-560(27 May 1974).

The ground state $d_{5/2}$ isobaric analog resonance for the ^{90}Zr(p,p$_0$)^{90}Zr reaction has been studied. Analysis of the data was carried out by means of a direct coupled-channels solution of the Lane equations. The effect of compound elastic scattering is shown to be important. (auth)

25626 THE DECAY OF ^{120}Xe. Muennich, F.; Lode, D.; Schrader, H. (Technische Univ. Braunschweig (F.R. Germany). Inst. A fuer Physik); Hoeglund, A. (Stockholm Univ. (Sweden). Fysiska Institutionen); Pessara, W. (Technische Univ. Braunschweig (F.R. Germany)). Nucl. Phys., A; 224: No. 3, 437-467 (27 May 1974).

The decay scheme of 40 min ^{120}Xe has been investigated using isotopically separated sources produced by the ISOLDE facility at CERN. A total number of 202 γ-transitions has been observed in this decay; 188 of them have been placed in a level scheme involving 34 excited states in ^{120}I. Most of these levels are based on the results of γ-γ coincidence experiments with two Ge(Li) detectors. Internal conversion coefficients have been obtained with a Si(Li) detector and a magnetic spectrometer. The half-life of 4 low-lying levels in ^{120}I has been measured by delayed coincidence techniques. From these measurements, partial half-lives for some transitions have been deduced and are compared with the single-particle estimates. Two E2 transitions are strongly enhanced. (auth)

25627 NUCLEAR DATA SHEETS FOR A = 99. Medsker, L. R. (Argonne National Lab., IL). Nucl. Data Sheets; 12: No. 4, 431-475(Aug 1974).

The 1960 version of the Nuclear Data Sheets for A = 99 was revised on the basis of experimental data received prior to August 1973. Information from approximately 160 papers and communications is included in the present compilation. (auth)

25628 LECTURES FROM THE THEORETICAL-PRACTICAL COURSE ON NUCLEAR MAGNETIC RESONANCE. Frigerio, A. Milan, Italy; Tamburini Editore (1973). 554p. (In Italian and English).

After a brief introduction, papers on the following subjects are presented: Introduction to the phenomenon of nuclear magnetic resonance; the chemical shift; effect of the solvent in nuclear magnetic resonance; spin coupling; auxiliary techniques in nuclear magnetic resonance; ^{13}C nuclear magnetic resonance techniques and applications; nuclear magnetic resonance of paramagnetic systems; shift reagents in nuclear magnetic resonance; biological applications of nuclear magnetic resonance; nuclear magnetic resonance in the study of natural substances; high-resolution nuclear magnetic resonance of polymers in solution; nuclear magnetic resonance of biopolymers; nuclear magnetic resonance and mass spectrometry in drug metabolism studies; complementary contributions of several spectroscopic methods in the determination of molecular structure; interpretation of proton nuclear magnetic resonance spectra (with 19 exercises). A collection of useful tables is also given. (RWR)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 23682, 25286, 25612, 25614, 25623, 25655, 25658, and 25687.

25629 (BNL-18976) DIRECT CAPTURE STUDIES IN THE 4-S GIANT RESONANCE REGION. Cole, G. W.; Chrien, R. E.

(Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 6p. (CONF-740920-2). Dep. NTIS $4.00.

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

Non-resonant radiative capture of epithermal neutrons was investigated for five targets in the range $152 \leq A \leq 186$. Significant direct reaction cross sections were observed for final states of good single-particle character. (3 figures, 2 tables) (auth)

25630 (CONF-740920-8) ENERGY LEVELS IN THE ODD-N Sm ISOTOPES. Smither, R. K. (Argonne National Lab., Ill. (USA)). 1974. 6p. Dep. NTIS $4.00.

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

Four different types of neutron-capture gamma-ray experiments were used to investigate the energy-level structure of the odd-N Sm isotopes. The gamma-ray branching ratios for the low-lying levels were used to help follow the level structure from the well-deformed ^{155}Sm and ^{153}Sm nuclei, through the transitions, ^{151}Sm, ^{149}Sm, and ^{147}Sm nuclei, to the near-spherical ^{145}Sm nucleus. (4 figures) (auth)

25631 (IPNO-TS-74-1) STUDY OF THE (Ar,xn) REACTIONS IN THE Pt–Po AREA AND PROSPECTS FOR THE PRODUCTION OF NEW ISOTOPES PRODUCED BY (Ca,xn) REACTIONS. Lagarde, B. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). May 1974. 60p. (In French). Dep. NTIS (U. S. Sales Only) $6.00.

Thesis.

The purpose of this thesis is to present the neutron-deficient isotopes which can be produced with a beam of Ca ions in the area of Pt, Pb, Bi, Po. The α decay and half-life will identify them. The well-known helium-jet technique was used to collect recoils. For this same area, the results obtained with a beam of Ar ions produced by the accelerator ALICE at ORSAY have been assembled; an analysis of these results has allowed determination of the maximum in energy of excitation functions for (Ca,xn) reactions and a simple fission–evaporation calculation (n,p,α) has allowed calculation of the cross sections of new isotopes produced by (Ca,xn) reactions. Finally, with α decay systematics, the energies, E_α, and half-lives, $T_{\frac{1}{2}}$, of these new isotopes have been estimated. (FR)

25632 (JINR-E6-8008) DECAY CHAIN ^{162}Yb(19.0 min) → ^{162}Tm(21.8 min) → ^{162}Er AND THE DECAY OF ^{160}Tm(9.2 min) TO ^{160}Er. Abdurazakov, A. A.; Beyer, G.; Gromov, K. Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 31p. Dep. NTIS (US Sales Only) $4.75.

The decay of ^{162}Yb, ^{162}Tm and ^{160}Tm was investigated with Ge(Li) and Si(Li) detectors by using isotopically separated samples produced by the YASNAPP facility at Dubna. The singles γ-ray spectrum, the positron spectrum, and $\beta-\gamma$ and $\gamma-\gamma$ coincidences were measured. Strong ytterbium and thulium activities were used for conversion electron measurements with high-resolution magnetic β spectrographs. 3, 134, and 39 new γ rays were attributed to the decays of ^{162}Yb, ^{162}Tm, and ^{160}Tm, respectively. Decay schemes of these isotopes are proposed. Three and 12 new levels were found in ^{162}Er and ^{160}Er, respectively. The Q values of ^{162}Yb, ^{162}Tm, and ^{160}Tm were determined to be ≤ 2.2 MeV, 4.6 ± 0.3 MeV, and 4.9 ± 0.5 MeV, respectively. (7 figures, 7 tables) (auth)

25633 (JINR-P-4-7223) STRUCTURE OF TRANSITIONAL Sm AND Gd ISOTOPES. Dzholos, R. V.; Dehnau, F.; Kartavenko, V. G.; Yansen, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 8p. (In Russian). INIS.

The properties of the collective states of transition nuclei in the region of Sm and Gd were analyzed. (tr-auth)

25634 (JINR-P4-8102) LEVEL DENSITY FOR DOUBLY ODD DEFORMED NUCLEI. Vornov, V. V.; Malov, L. A.; Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The level density for doubly odd deformed nuclei near the neutron binding energy, B_n, was calculated in the framework of the semimicroscopic approach. The calculated values were found to be in agreement with the experimental ones. It was shown that for the $I \geq 1$ states it is important to take into account rotational motion. (1 table) (auth)

25635 (JINR-P6-8005) DECAY OF ^{160}Ho ISOMERS AND PROPERTIES OF ^{160}Dy. Aleksandrov, A. A.; Buttsev, V. S.; Vylov, Ts.; Grigor'ev, E. P.; Gromov, K. Ya.; Kalinnikov, V. G.; Lebedev, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 25p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The decay schemes of ^{160m}Ho(5h,2$^-$) and ^{160g}Ho(25 min,5$^+$) are suggested. A series of previously unknown ^{160}Dy excited states is introduced. The data on the band with $K = 0^+$ built on the 1280.0-keV level ($X = 0.26 \pm 0.08$) are made more accurate. The mixing parameters of the ground-state band and the bands built on the 4^+ levels at 1694 and 2096 keV with the γ band are equal to 0.020 ± 0.0002, 0.030 ± 0.003, and 0.037 ± 0.005, respectively. The strength function of the β decay of ^{160}Ho is analyzed, and conclusions are drawn on the fragmentation of the wave function of the $I^\pi = 1^-$, n523↓–n651↑ state over a number of levels in the region from 2.6 to 2.8 MeV. (3 figures, 3 tables) (auth)

25636 (UCRL-75726) CAPTURE GAMMA-RAY RESEARCH AT LAWRENCE LIVERMORE LABORATORY. Mann, L. G.; Lanier, R. G.; Larsen, J. T.; Richards, W. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1974. 7p. (CONF-740920-5). Dep. NTIS $4.00.

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

A filtered external neutron beam from the Livermore pool-type reactor is used for capture γ-ray research. Two Ge(Li) detectors are used either singly or in coincidence. One detector can be operated in the Compton suppression mode, and the other, in the pair spectrometer mode. In coincidence work three parameters (γ,γ,t) are stored and analyzed. A bent-crystal spectrometer of the Cauchois type has recently become operational for use with sources in the reactor through tube. Recent data on ^{181}Ta and ^{160}Tb are presented. (6 figures) (auth)

25637 AVERAGE ELECTRIC QUADRUPOLE MOMENTS OF EXCITED STATES OF DEFORMED EVEN–EVEN NUCLEI. Begzhanov, R. B.; Abdurakhmanov, S. R.; Belen'kii, V. M. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 11, 26-28(1973). (In Russian).

Available experimental data on quadrupole moments of the first 2^+ states of deformed even nuclei with $150 \leq A \leq 196$ and values of $\langle Q \rangle_{21}$ were assembled and organized. Calculations based on these data indicated that the RV model satisfactorily describes the data of concern. The data are tabulated in the article. (TTT)

25638 INTERACTION OF 28-GeV PROTONS WITH TANTALUM: CHARGE DISPERSION AND MASS YIELDS OF LIGHT RARE-EARTH NUCLIDES. Chu, Y.Y.; Franz, E.M.; Friedlander, G. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 10: No. 1, 156-166 (July 1974).

Independent and cumulative yields of 24 light rare-earth nuclides between mass 143 and mass 157 produced in the interaction of 28-GeV protons with tantalum have been measured. Charge dispersion (CD) curves for masses 146, 148, and 149 have been constructed based on the results obtained from this work with the aid of some previously published data. The importance of feeding by α decay is discussed in detail. The difference between the position of the peak of the CD curve and that of β stability Z_p–Z_A appears to decrease from ~3.4 at A = 146 to ~2.5 at A = 149. The total yields at these masses and at A = 123 were evaluated from measured yields and CD curves. The trend of the mass yields over this range is a monotonic decrease with decreasing mass, consistent with a spallation mechanism. Comparison with Rudstam's spallation systematics shows fair agreement regarding the shapes of the CD and mass-yield curves, but with Rudstam's parameter choices the cross sections are overestimated and the Z_p–Z_A values are not accurately reproduced. Comparison is made between the CD curves obtained in this work and those previously reported for U interactions. The observations are consistent with the interpretation that the light rare-earth products from tantalum results from a spallation-like process, whereas there must be some fission contribution to the slightly neutron-deficient nuclides produced from uranium. (auth)

25639 FISSION AND COMPLETE-FUSION PROBABILITIES AS A FUNCTION OF ANGULAR MOMENTUM FOR ^{170}Yb COMPOUND NUCLEI EXCITED TO 107 MeV. Zebelman, A.M.; Kowalski, L.; Miller, J.; Beg, K.; Eyal, Y.; Jaffe, G.; Kandil, A.; Logan, D. (Department of Chemistry, Columbia University, New York, New York 10027). Phys. Rev. C 10: No. 1, 200-213 (July 1974).

Fission and complete-fusion cross sections are presented for four entrance channels leading to ^{170}Yb compound nuclei excited to 107 MeV: ^{11}B + ^{159}Tb, ^{12}C + ^{158}Gd, ^{16}O + ^{154}Sm, and ^{20}Ne + ^{150}Nd. The measured fission cross sections are 5.9 ± 0.6, $16. \pm 2.$, $40. \pm 4.$, and 89.0 ± 9.0 mb for the ^{11}B, ^{12}C, ^{16}O, and ^{20}Ne entrance channels, respectively. The complete-fusion cross sections for these same entrance channels are 980 ± 150, 1100 ± 160, 1260 ± 190, and 1450 ± 220 mb. The data are combined using a technique which yields the dependence of fission probability over three relatively narrow ranges of angular momentum. The results of the analysis just described are compared to a calculation based on the Bohr-Wheeler formalism for fission widths and the Weisskopf formalism for neutron and charged-particle widths. The calculations include the effects of multiple

chance fission but assume that second and higher chance fission is nonnegligible only if preceded by neutron emission rather than charged particle emission. Agreement between the experimental results and the theoretical calculations is found for a ratio of level density parameters for the compound nucleus and the saddle point equal to 1.2 ± 0.1. Fission-fragment angular distributions for the four entrance channels are presented and compared to calculations. (auth)

25640 α-DECAY BRANCHING RATIOS FOR HIGH- AND LOW-SPIN ISOMERS IN ^{151,152,153,154}Ho. Schmidt-Ott, W. (UNISOR, Oak Ridge, Tennessee 37830); Toth, K.S.; Newman, E.; Bingham, C.R. Phys. Rev. C 10: No. 1, 296-306 (July 1974).

α-decay branching ratios were obtained for high- and low-spin isomers in ^{151,152,153,154}Ho. These activities were produced by bombarding ^{144,147}Sm with ^{11,10}B ions, respectively, accelerated in the Oak Ridge isochronous cyclotron. With the use of a gas-jet-capillary transport system it was possible to do α-particle, x-ray, and γ-ray counting simultaneously. Branching ratios were deduced in the main by determining the number of $K\alpha_1$ x rays emitted and then applying appropriate correction factors to obtain the total number of electron-capture and positron decays. For ^{152,154}Ho, where the γ-ray spectral measurements could be used to extract information concerning their decay to ^{152,154}Dy, it was possible to deduce alternate, and thus independent, α-decay branching ratios. (Incidently, our results confirm those of Ward and Neiman for the decay of the high-spin ^{154}Ho isomer to levels in ^{154}Dy.) Within error limits the two sets of ratios for ^{152,154}Ho were found to be in agreement. For the two cases, i.e., 35.6-sec ^{151}Ho and 9.3-min ^{153}Ho, where experimental α-decay branches had been previously measured our data agree with the earlier results. α-decay reduced widths were calculated by using the formalism developed by Rasmussen and compared with values for neighboring even-even nuclei, which can be taken to represent unhindered α-decay. The present study is the first systematic investigation of α-decay rates for a series of isotopes of an odd-Z element in the rare earth region. It was found that, as for odd-A isotopes in the heavy-element region, the α-decay reduced widths range from those of even-even nuclei down to much smaller values. (auth)

25641 ELECTRIC MOMENTS AND CHARGE DEFORMATION IN EVEN RARE-EARTH NUCLEI. Shaw, A.H.; Greenberg, J.S. (Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. C 10: No. 1, 263-283 (July 1974).

We present measurements of E2 and E4 transition matrix elements, and related β_2 and β_4 deformations, for eight even rare earth nuclei, by exploiting the effect of electric quadrupole and electric hexadecapole excitation on the multiple Coulomb excitation of states in their ground state bands. The Coulomb excitation probabilities for the 0^+, 2^+, and 4^+ states in the ground state bands of the even rare earth nuclei ^{152,154}Sm, ^{158,160}Gd, ^{164}Dy, ^{166,168}Er, and ^{174}Yb have been measured with ^{4}He projectiles, at several incident energies below the respective Coulomb barriers, by direct detection, at backward angles, of elastically and inelastically scattered particles. The direct detection of scattered ^{4}He particles was employed in order to eliminate the uncertainties involved in the detection of the deexcitation γ rays, and to facilitate the determination of $M(E2;0^+ \rightarrow 2^+)$ to about the 1/2% accuracy required to obtain a meaningful measurement of $M(E4;0^+ \rightarrow 4^+)$. Coulomb-nuclear interference effects in elastic and inelastic scattering were investigated, and it was demonstrated that Coulomb nuclear interference occurs at a much lower projectile energy than predicted by the simple classical formula for the Coulomb barrier, and manifests itself at different incident energies for elastic and inelastic scattering. The data on excitation probabilities were analyzed both with a semiclassical Coulomb excitation calculation, corrected for quantal effects in second order perturbation theory, and with a full quantal calculation, to determine the reduced electric transition matrix elements $M(E2;0^+ \rightarrow 2^+)$ and $M(E4;0^+ \rightarrow 4^+)$. Significant differences were found between the perturbation theory quantal treatment and the full quantal calculations. Static quadrupole and hexadecapole moments of the charge distribution were extracted from the measured transition matrix elements within the context of the rotational model. Using an axially symmetric deformed Fermi shape to parametrize the charge distribution, charge deformation parameters β_2^C and β_4^C, deduced from the static moments, were found to follow the same general trends as the potential deformation parameters measured in nuclear scattering experiments well above the Coulomb barrier. For some nuclei the Coulomb excitation β_λ^C values show what may be significant deviations from the nuclear potential deformations parameters. However, it is emphasized that, presently, the significance of such a comparison as well as the significance of a comparison with deformation parameters determined with other electromagnetic probes, is subject to the considerations introduced by the model dependence of each measurement, and diluted by the ambiguous correspondence between the quantities being measured in the different experiments. (auth)

25642 MEASUREMENT OF THE ^{11}B + ^{159}Tn COMPLETE-FUSION CROSS SECTION. Kozub, R.L.; Logan, D.; Miller, J.M.; Zebelman, A.M. (Department of Chemistry, Columbia University, New York, New York 10027). Phys. Rev. C 10: No. 1, 214-216 (July 1974).

The complete-fusion cross section for the ^{170}Yb compound system, formed in the reaction of 115 MeV ^{11}B + ^{159}Tb, has been measured using a counter telescope containing a thin gas proportional counter and a Si surface-barrier detector. The result is in excellent agreement with that obtained using mica track detectors. (auth)

25643 INFLUENCE OF THE PARTICLE-NUMBER FLUCTUATION ON THE E1 $\Delta K = \pm 1$ TRANSITIONS IN DEFORMED ODD-MASS NUCLEI. Fellah, M.; Hammann, T.F. (Institute of Nuclear Studies, Algiers, Algeria). Phys. Rev. C 10: No. 1, 284-295 (July 1974).

Dipole electric transitions with $\Delta K = \pm 1$ are studied theoretically for odd-mass nuclei in the rare-earth region (i) in the frame work of an elaborated Nilsson model with rotation-particle coupling and with isospin-dependent parameters, (ii) with the usual BCS wave function, and (iii) with sharp particle-number-projected BCS wave functions. These projected wave functions are the limit of very speedily converging sequences of functions. General formulas for the pairing reduction factors with strict nucleon number conservation are established. The unphysical effects due to particle fluctuation in the usual BCS wave functions are found to be very important in the theoretical BCS evaluation of reduction factors and half-lives. In most of the analyzed E1 transitions, the hindrance factors are improved by the elimination of the unphysical effects due to particle fluctuation. The blocking effect is systematically taken into account. The importance and validity of the physical and mathematical approximations used is discussed. (auth)

25644 EXPERIMENTAL STUDY OF COLLECTIVE PROPERTIES OF ^{152}Sm BY MULTIPLE COULOMB EXCITATION. Domingos, J.M. (Departamento de Fisica, Universidade de Coimbra, Coimbra, Portugal and Nuclear Physics Laboratory, Oxford, England); Symons, G.D.; Douglas, A.C. Phys. Rev. C 10: No. 1, 250-262 (July 1974).

Collective states in ^{152}Sm have been studied by multiple Coulomb excitation with 41.0-59.1 MeV ^{16}O ions. The excitation probabilities for the 2^+, 4^+, 6^+, and 8^+ states of the ground-state rotational band, the 0^+, 2^+, and 4^+ states of the β vibrational band, the 2^+ and 4^+ states of the γ vibrational band and the 1^-, 3^-, and 5^- states of the octupole band have been measured. The angular correlations and branching ratios for the strongest transitions deexciting these states have also been measured. From these correlations the E2/M1 mixing ratios have been obtained for the 2_β-2, 4_β-4, 2_γ-2, and 4_γ-4 transitions. Deviations of both the branching ratios from the β and γ bands and the excitation probabilities for states in the ground-state band from the simple rotational predictions are examined in terms of the modified rotational model with first-order band mixing between the ground-state band, γ, and β bands. It is shown that, although this model gives satisfactory agreement with the multiple Coulomb excitation theory for the excitation probabilities, the branching ratios for decay of the 2_β and 4_β states are not consistent, as has previously been shown in radioactive decay studies. The transition probabilities within the ground state-band and from the 0_β state are compared with recent accurate measurements of the lifetimes of these states by the recoil-distance Doppler shift technique. (auth)

25645 NUCLEAR DATA SHEETS FOR A = 160. Tuli, J. K. (Indiana Univ., Bloomington). Nucl. Data Sheets; 12: No. 4, 477-531(Aug 1974).

Nuclear data on nuclides with mass 160 based upon nuclear reactions and radioactive decay studies are presented. It was attempted to include all experimental information received prior to July 1, 1973. The compilers' discussion of spin assignments, level and gamma-ray properties, and other comments precede the experimental data on each nuclide. For clarity, some of the older data were omitted. (auth)

25646 NUCLEAR DATA SHEETS FOR A = 185. Ellis, Y. A. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 12: No. 4, 533-584(Aug 1974).

The available nuclear structure information for all nuclei with mass number A = 185 is presented. Experimental data and their evaluation; comparison with theory, where possible; and arguments for spin, parity, and Nilsson-state assignments are given. Inconsistencies and discrepancies are indicated. The adopted level and decay properties are based on data received before August 1973. Data received from that date up to February 1974 are added in proof. (auth)

25647 THE HYPERFINE INTERACTION FOR ^{155}Gd IN Gd METAL. Jonsson, B.; Golczewski, J.; Bostroem, L.; Karlsson, E. (Uppsala Univ. (Sweden). Fysiska Institutionen). Phys. Lett., A; 48: No. 1, 57-58(20 May 1974).

The hyperfine interaction for ^{155}Gd in Gd has been investigated in the temperature range 10-300 K using the DPAC method. The temperature dependence of B_{Gd} (Gd) and the g-factor of the 87 keV excited state in ^{155}Gd were deduced. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 25580, 25581, 25584, 25612, 25614, 25621, 25624, 25631, 25637, and 25687.

25648 (IPNO-RC-73-06) FUSION AND FISSION INDUCED BY ^{84}Kr IONS ON ^{209}Bi. Lefort, M.; Ngo, C.; Peter, J.; Tamain, B. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). 1973. 14p. Dep. NTIS (U. S. Sales Only) $4.00.

Fragments emitted in binary fission from complete fusion nuclei have been investigated for krypton-induced reactions on ^{209}Bi and ^{238}U. Cross sections are lower than 5% of the total reaction cross section. It is deduced that the complete fusion between krypton projectiles and heavy nuclei is a very improbable process. Most of the reaction products seem to result from a very inelastic interaction which looks like a very asymmetric fission. (auth)

25649 (JINR-P6-8078) DECAY OF ^{192}Tl AND ^{190}Tl. Vandlik, T. B.; Vandlik, Ya.; Zaitseva, N. G.; Mate, Z.; Makhunka, L; Makhunka, M.; Tyrroff, Kh.; Fenesh, T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 25p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

Gamma and conversion electron spectra of mass-separated ^{192}Tl and ^{190}Tl samples were measured with the aid of Ge(Li) and Si(Li) detectors. In the case of ^{192}Tl 49 gamma transitions were observed, of which 40 are new. Multipolarities of 22 transitions were determined. The (2^-) ground state ($T_{1/2}$ = 10.6 ± 0.5 min) and (7^+) metastable state ($T_{1/2}$ = 10.8 ± 0.2 min) of ^{192}Tl decay by e^- capture (98.2%) and β^+ emission (1.8 $^{+1.3}_{-0.5}$%). A decay scheme of ^{192}Tl is proposed with the following energy levels of ^{192}Hg : 0 keV, $I^\pi = 0^+$; 422.8, 2^+; 1057.9, 4^+; 1113.8, 2^+; 1592.9, (3^+); 1733.4, (3.2^+); 1803.6, 6^+; 1844.5, $(5)^-$; 1977.6, $(7)^-$; and 2187.1, $(6.5)^-$. In the ^{190}Tl decay 21 gamma-transitions were observed, of which 13 are new. Multipolarities of 9 transitions were determined. A decay scheme of ^{190}Tl is proposed with the following energy levels of ^{190}Hg: 0 keV, $I^\pi = 0^+$; 416.5, 2^+; 1041.9, 4^+; 1099.9, (2^+); 1557.6, (3^+); 1772.9, 6^+; 1881.5. $(5)^-$; 2078.2, $(7)^-$. From energy level systematics of even Tl isotopes and from the decay scheme of ^{190}Tl one can draw the conclusion that in the ^{190}Tl nucleus there exist two isomeric states with similar half-lives: (2^-) $T_{1/2}$ = 3.4 ± 0.3 min and (7^+) $T_{1/2}$ = 3.4 ± 0.2 min. The isomeric states decay mainly with e^- capture (97.4%), the intensity of the β^+ branch is only $2.6^{+2.6}_{-0.6}$%. (7 figures, 5 tables) (auth)

25650 (NP-20100) EFFECT OF MONOPOLE VIBRATIONS UPON CHARGE DISTRIBUTIONS. Saarela, M. (Oulu Univ. (Finland). Dept. of Theoretical Physics). [nd]. 12p. Dep. NTIS (US Sales Only) $4.00.

The charge distributions of ^{209}Bi and ^{208}Pb and the isomer shifts in ^{209}Bi and ^{207}Pb were used to study the effect of monopole vibrations. (1 figure, 1 table) (auth)

25651 SPECTRA OF NEUTRONS FROM μ CAPTURE IN THALLIUM, LEAD AND BISMUTH. Schroeder, W. U. (Technische Univ. Darmstadt (F. R. Germany). Inst. fuer Kernphysik); Jahnke, U.; Lindenberger, K. H.; Roeschert, G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)); Engfer, R.; Walter, H. K. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Hochenergiephysik). Z. Phys.; 268: No. 1, 57-64(May 1974).

6 figs.; 1 tab.; 16 refs. Part of a thesis by Schroeder.

The energy distributions of neutrons from μ capture in Tl, Pb, and Bi were measured applying a time-of-flight technique, using de-excitation γ-rays from final nuclei as a time reference. The spectra exhibit an evaporation part, which is described by nuclear temperatures varying from θ = 1.06 MeV for Bi to θ = 1.22 MeV for Pb, and an exponentially decreasing high-energy distribution with a relative intensity of approximately 10%, which is interpreted, on the basis of a simple model, as being due to direct and precompound processes. (auth)

25652 FORMATION CROSS SECTIONS OF NUCLIDES PRODUCED FROM HEAVY ELEMENTS BY HIGH-ENERGY PROTON BOMBARDMENT. Gupta, B. K.; Das, S. (Calcutta Univ. (India). Dept. of Physics). Z. Naturforsch., a; 29: No. 5, 822-825(May 1974).

3 figs.; 2 tabs.; 18 refs.

Theoretical cross sections for the production of elements from ^{209}Bi and natural copper by high-energy proton bombardment have been calculated. (auth)

25653 OPTICAL-MODEL ANALYSIS OF p + ^{208}Pb ELASTIC SCATTERING FROM 15-1000 MeV. van Oers, W.T.H.; Haw, H.; Davison, N.E. (Cyclotron Laboratory, Department of Physics, University of Manitoba, Winnipeg, Canada); Ingemarsson, A.; Fagerström, B.; Tibell, G. Phys. Rev. C 10: No. 1, 307-319 (July 1974).

Measurements have been made of the differential cross sections for p + ^{208}Pb elastic scattering at mean proton energies of 21.0, 24.1, 26.3, 30.5, 35.0, 45.0, and 47.3 MeV. Measurements have also been made of the differential cross sections and polarizations at 185 MeV. These data together with the data in the energy range 15–1000 MeV available in the literature have been analyzed in terms of a standard 11-parameter optical model. Relativistic corrections to the optical-model analysis were introduced. The energy dependence of the real central potential (as indicated by the volume integral per nucleon and by the strength parameter) can be represented by a linear relation if a limited energy range is chosen. This linear energy relation cannot be extrapolated to higher energies since it makes the real central potential repulsive at too low an energy as indicated by the results of optical-model analyses of proton scattering data above 200 MeV. A logarithmic energy dependence gives a reasonable presentation of the volume integral per nucleon of the real central potential for energies up to 1 GeV. (auth)

25654 ^{6}Li,^{7}Li INDUCED REACTIONS ON ^{209}Bi. Freiesleben, H.; Britt, H.C.; Birkelund, J.; Huizenga, J.R. (Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627). Phys. Rev. C 10: No. 1, 245-249 (July 1974).

Results are reported on experimental measurements of total cross sections for (^{6,7}Li, xn), (^{6,7}Li, f), (^{7}Li, αxn), (^{7}Li, txn), and (^{7}Li, αp) reactions on a ^{209}Bi target at bombarding energies in the range 25–34 MeV. At ^{7}Li bombarding energies of 32 and 30 MeV, the cross sections for transfer reactions are 57 and 70%, respectively, of the total measured cross section. At energies below the Coulomb barrier, the cross section for transfer reactions becomes considerably larger than those for compound nucleus reactions. (auth)

25655 EVIDENCE FOR ASYMMETRIC SHAPES FROM HIGH-SPIN ODD-A SPECTRA. Meyer ter Vehn, J.; Stephens, F.S.; Diamond, R.M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 32: No. 24, 1383-1386 (17 June 1974).

The model of a single-j nucleon coupled to an asymmetric rotor is applied to new experimental results on yrast bands in ^{187}Ir, ^{193}Au, and ^{191}Tl. The core asymmetry is shown to account for systematic trends in the high-spin spectra. Information on the shape dependence of moments of inertia is obtained which supports the idea of nuclear flow of irrotational type. (auth)

25656 j DEPENDENCE OF THE VECTOR ANALYZING POWER FOR (d, ^{3}He) AND (d, t) REACTIONS. Mayer, B.; Conzett, H.E.; Dahme, W.; Kovar, D.G.; Larimer, R.M.; Leemann, C. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 32: No. 25, 1452-1454 (24 June 1974).

Angular distributions of cross sections and vector analyzing powers were measured in the reactions ^{208}Pb(d, ^{3}He)^{207}Tl and ^{208}Pb(d, t)^{207}Pb at 30 MeV. The vector analyzing powers show a strong j dependence in both reactions. The distorted-wave Born approximation provides qualitative fits to the data for several transitions in ^{208}Pb. (auth)

25657 4843-keV, 1^+ LEVEL OF ^{208}Pb. Swann, C.P. (Bartol Research Foundation of the Franklin Institute, Swarthmore, Pennsylvania 19081). Phys. Rev. Lett. 32: No. 25, 1449-1451 (24 June 1974).

From measurements of resonance-fluorescence cross section, angular distribution, and polarization, the 4843-keV level of ^{208}Pb has been shown to have a 1^+ character and a width of 5.1±0.8 eV with all of the decays to the ground state. As the probable lower member of the giant M1 excitation, this state is at a significantly lower energy and has a decay strength which is an order of magnitude larger than the predictions of simple shell-model calculations. (auth)

25658 DIFFRACTION SCATTERING OF MEDIUM-ENERGY PARTICLES BY ATOMIC NUCLEI. Berezhnoi, Yu. A.; Shlyakhov, N. A. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 6, 959-964(Jun 1974). (In Russian).

The integral representation of the elastic scattering amplitude was obtained on the basis of the Ostrogradsky summation formula. The accuracy of the expression obtained was evaluated. The elastic scattering amplitude determined takes into account correctly the Coulomb interaction and contains different special cases investigated earlier. The cross sections for neutron, proton, pion, α-particle, and heavy-ion elastic scattering by atomic nuclei were calculated on the basis of the elastic scattering amplitude determined. The results of the theoretical calculations were in agreement with the experimental data. (6 figures, 1 table) (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 23610, 24611–24616, 25582, 25611, 25612, 25621, and 25634.

25659 (AERE-PR/NP-20, pp 9-10) EVALUATIONS OF THE CROSS SECTIONS OF ACTINIDES. Sowerby, M. G.; Patrick, B. H.; North, R.; Bowey, E. M. (Atomic Energy Research Establishment, Harwell, Eng.). Jan 1974.

25660 (AERE-PR/NP-20, pp 30-33) $^{240}Pu(n,\gamma)^{241}Pu$ REACTION. Thomas, B. W. (Atomic Energy Research Establishment, Harwell, Eng.); Haste, T. J. Jan 1974.

25661 (AERE-R-7209) FISSION PRODUCT CHAIN YIELDS FROM EXPERIMENTS IN THERMAL REACTORS. Crouch, E. A. C. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1973. 36p. Dep. NTIS (US Sales Only) $5.00.

Published values of the yields of fission products from the thermal-neutron-induced fission of ^{227}Th, ^{229}Th, ^{233}U, ^{235}U, ^{239}Pu, ^{241}Pu, ^{242m}Am, ^{245}Cm, and ^{249}Cf and from the "pile"-neutrons-induced fission of ^{227}Ac, ^{231}Pa, ^{233}Th, ^{237}U, ^{237}Np, and ^{241}Am are assessed, and recommended values for the chain yields are listed. (16 tables, 688 references) (auth)

25662 (IPNO-PhN-73-09) SEARCH FOR SUPERHEAVY ELEMENTS IN NATURE. Stephan, C.; Tys, J.; Sowinski, M.; Cieslak, E.; Meunier, M. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). 1973. 33p. Dep. NTIS (U. S. Sales Only) $4.75.

Superheavy elements have been sought by neutron-induced fission of mass-separated samples. Various natural materials have been investigated: minerals, manganese nodules, lunar dust, meteorite. Fissioning masses have been collected in the A = 300 mass region. No conclusions could be drawn about the existence of superheavy elements because of a possible contamination of this mass region by molecules containing natural uranium or thorium. However, most of neutron fission cross sections which have been determined for these masses cannot be understood if due to the fission of U or Th atoms. Some complementary results concerning the properties of the atoms contained in these masses are also given. (auth)

25663 (JINR-P15-8095) MULTIPLICITY OF PROMPT NEUTRONS FROM SPONTANEOUS FISSION OF THE ISOTOPE $^{252}102$. Lazarev, Yu. A.; Dakovskii, M.; Nefed'ev, O. K.; Oganesyan, Yu. Ts. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The average number of prompt neutrons, $\bar{\nu}$, emitted in the spontaneous fission of the isotope of element 102 with mass number 252 and a half-life of 2.4 s was measured to be 4.15 ± 0.30 relative to $\bar{\nu} = 2.69 \pm 0.01$ for the spontaneous fission of ^{244}Cm. (3 figures) (auth)

25664 (UCID-15458) MEASUREMENT OF ^{239}Pu AND ^{235}U CAPTURE AND FISSION CROSS SECTIONS. Czirr, J. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Mar 1969. 9p. Dep. NTIS $4.00.

The capture and fission cross sections and their ratio, α, were measured for ^{239}Pu and ^{235}U for neutrons in the 100 eV to 10 keV energy range. Preliminary results are presented for the quantity $\langle\sigma_C\rangle/\langle\sigma_f\rangle$ in convenient energy bins over the above energy range. A new measurement technique was employed in an effort to resolve present discrepancies in the measured values of this ratio. (auth)

25665 (UCID-16548) HIGH-ENERGY MEASUREMENTS OF NEUTRON-INDUCED FISSION CROSS-SECTION RATIOS INVOLVING ^{233}U, ^{235}U, ^{238}U, AND ^{239}Pu USING THE METHOD OF THRESHOLD CROSS SECTIONS. Behrens, J. W.; Carlson, G. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Jul 1974. Contract W-7405-eng-48. 41p. Dep. NTIS $5.00.

Fission-cross-section measurements for a wide collection of uranium and plutonium isotopes are being conducted at LLL by using the 100-MeV electron linear accelerator (Linac) as a pulsed neutron source. The cross section ratios are measured as a function of neutron energy from 1 keV to 30 MeV by using the time-of-flight technique. To obtain fission cross section ratios above 1 MeV, the threshold cross section method was used. This method allows one to obtain the ratios without depending on normalizations to absolute cross section measurements. Knowledge of neither the amount of fissionable mass nor the efficiency for detecting fissions in the fission chambers is required for the analysis. This advantage eliminates a potentially large uncertainty in ratio measurements. Preliminary results for the fission cross section ratios $^{236}U/^{233}U$, $^{238}U/^{235}U$, and $^{238}U/^{239}Pu$ extend from 1 to 30 MeV with an energy resolution of at least 5% and counting uncertainties less than 5% over most of the energy range. Additional preliminary measurements of the fission cross section ratios $^{233}U/^{235}U$ from 1 keV to 30 MeV, $^{238}U/^{235}U$ from 750 keV to 30 MeV, and $^{239}Pu/^{235}U$ from 10 keV to 30 MeV are reported with an energy resolution of at least 5% and counting uncertainties less than 3% over most of the energy range. These ratios were normalized by using the threshold cross section method. (23 figures, 3 tables) (auth)

25666 EXCITED STATES OF ODD ATOMIC NUCLEI DEFORMED IN THE GROUND STATE. Israilov, A. A.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 10, 20-21(1973). (In Russian).

Calculated energies of rotational single-particle states of odd nuclei are presented graphically as a function of nonaxiality parameter, γ, with fixed values of the parameters of the relation between rotational movement ($\xi = 0.25$) and equilibrium deformation ($\beta = 0.3$). Disruption of the symmetry at $\gamma = 30°$ is greater than for published values for even–even nuclei. Data are tabulated for ^{233}U with $\xi = 0.25$, $\gamma = 14.5°$, and $\beta = 0.3$. (1 figure, 1 table) (TTT)

25667 NUCLEAR PROPERTIES OBTAINED FROM THE OPTICAL SPECTRA OF ATOMS. Nuclear Moments and Isotropic Shifts for Actinides and the Rare Earths Series. Gerstenkorn, S. (CNRS, Orsay, France). J. Phys. (Paris), Colloq.; No. 4, 55-62 (1973). (In French).

From Centenary congress on the French Physical Society; Vittel, France (28 May 1973).

High-resolution studies of atomic spectra by means of Fabry–Perot interferometry and Fourier spectrometry have led to the determination of the nuclear moments (μ and Q) of the uranium isotopes 233 and 235 and of the thorium isotope 229. These results are included in an up-to-date collection of data for the actinide region. In addition, the values of $\langle r^2\rangle$ (mean square radius of the charge distribution) of the rare earths and actinides are given, taking into account recent measurements and fine structure studies. Finally, in the vicinity of the closed neutron shell (N = 50,82), it is shown that the variation of $\langle r^2\rangle$ and E (binding energy of the neutrons) is of opposite sign. (FR)

25668 SPECTRUM OF PROTONS IN FISSION OF ^{252}Cf. Gavron, A. (Nuclear Physics Department, The Weizmann Institute of Science, Rehovot, Israel); Gazit, Y. Phys. Rev. C 10: No. 1, 388-390 (July 1974).

The spectrum of protons in fission of ^{252}Cf has been measured using an improved collimation technique, which eliminates a large part of the background. The most probable proton energy was determined to be 7.8 $\pm$ 0.2 MeV and the spectrum full width at half-maximum, 6.1 $\pm$ 0.3 MeV. The number of protons emitted per long range α particle is $(1.6 \pm 0.1) \times 10^{-2}$. (auth)

25669 ABSOLUTE CROSS SECTIONS FOR PROTON-INDUCED FISSION OF THE URANIUM ISOTOPES. Boyce, J.R.; Hayward, T.D.; Bass, R.; Newson, H.W.; Bilpuch, E.G.; Purser, F.O. (Triangle Universities Nuclear Laboratory, Duke University, Durham, N. C. 27706); Schmitt, H.W. Phys. Rev. C 10: No. 1, 231-244 (July 1974).

Absolute cross sections for proton induced fission have been measured for ^{233}U, ^{234}U, ^{235}U, ^{236}U, and ^{238}U for proton energies ranging from 5.0 to 30.0 MeV. Angular distributions have been measured for all isotopes and the fission fragment angular anisotropy determined as a function of excitation energy. Excitation data were accumulated at 250 keV intervals with smaller steps in regions of special interest. Fission probabilities calculated from the data and optical model predictions prominently display effects due to the opening of additional fission channels as excitation energy is increased. A method of analysis is formulated and demonstrated which makes use of the extended energy range and selection of an isotopic sequence of target nuclei to unfold the contributions to the measured cross section from first, second, and third chance fission. Using this method, previously undetermined fission thresholds and Γ_n/Γ_f ratios are estimated for individual nuclei as functions of excitation energy. (auth)

25670 REDETERMINATION OF THE HALF-LIFE OF ^{235}U FOR α EMISSION: A REPLY. Jaffey, A.H. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 10: No. 1, 386-387 (July 1974).

It is likely that measurements of the ^{235}U half-life through α pulse analysis of natural uranium are subject to a systematic bias owing to interference by the dominating ^{234}U and ^{238}U peaks. (auth)

25671 INTERACTION OF ^{238}U WITH 300- AND 11.5-GeV PROTONS: CROSS SECTIONS AND RECOIL PROPERTIES IN THE A~130 MASS REGION. Yu, Y.W.; Porile, N.T. (Department of Chemistry, Purdue University, Lafayette, Indiana 47907). Phys. Rev. C 10: No. 1, 167-172 (July 1974).

Formation cross-sections and thick-target recoil properties of 13 products in the A~130 mass region from the interaction of ^{238}U with 300- and 11.5-GeV protons have been determined. The values of $\sigma_{300}/\sigma_{11.5}$ are consistent with unity for A > 130 and decrease with decreasing A below this mass number, a trend that is most notably exhibited by neutron deficient iodine nuclides. The recoil ranges and F/B values are essentially the same at both energies. (auth)

25672 REDETERMINATION OF THE HALF-LIFE OF ^{235}U FOR α EMISSION. Deruytter, A.J. (Central Bureau voor Nucleaire Metingen, 2440 Geel, Belgium); Wegener-Penning, G. Phys. Rev. C 10: No. 1, 383-385 (July 1974).

Measurements with a low counting geometry and a 99.999% ^{235}U source were carried out to determine branching ratios in the α decay. The ^{235}U half-life was calculated, relative to that of ^{238}U. The result is $T_{1/2}(^{235}U) = (6.85 \pm 0.09) \times 10^8$ yr. (auth)

25673 TOTAL REACTION CROSS SECTIONS OF DEFORMED NUCLEI: A STUDY OF THE $^{233,235}U + \alpha$ SYSTEMS. Freiesleben, H.; Huizenga, J. R. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.). Nucl. Phys., A; 224: No. 3, 503-516(27 May 1974).

The cross sections for α-particle induced fission of $^{233,235}U$ were measured at bombarding energies of 15 to 27 MeV. For these fissionable systems, the fission cross sections are very nearly equal to the total reaction cross section. These experimental reaction cross sections are compared with various theories based on spherical and deformed potentials in order to investigate the effect of static target deformation on the reaction cross sections. From such comparisons no effect of target is established. An interaction barrier (defined by the condition $T_L = 0 = \frac{1}{2}$) of 22.34 MeV is obtained from a spherical optical model fit to the experimental reaction cross-section data of uranium. The value agrees within 2.3% with values deduced by a number of other methods. (auth)

25674 HYPERFINE INTERACTIONS AND NUCLEAR MOMENTS IN EVEN URANIUM ISOTOPES FROM MOESSBAUER SPECTROSCOPY. Meeker, R. D.; Kalvius, G. M.; Dunlap, B. D.; Ruby, S. L.; Cohen, D. (Argonne National Lab., Ill. (USA)). Nucl. Phys., A; 224: No. 3, 429-436(27 May 1974).

Nuclear γ-resonance (Mossbauer effect) measurements have been performed using the 45 keV, $0^+ \rightarrow 2^+$ transition in ^{234}U, ^{236}U and ^{238}U. Values are obtained for the ratio of quadrupole moments of the 2^+ level in these isotopes, $Q(234):Q(236):Q(238) = 1:(1.13 \pm 0.09):(1.13 \pm 0.10)$, and for the magnetic moments of the 2^+ level, $\mu(234):\mu(236):\mu(238) = 1:(0.98 \pm 0.06):(0.94 \pm 0.09)$. No isomer shifts are detected, placing an upper limit on the change in nuclear mean square charge radius of $|\Delta < r^2 > | \leq 2 \times 10^{-4}$ fm^2 for all three isotopes. Relative merits of the three uranium isotopes for nuclear γ-resonance spectroscopy are discussed, and some preliminary attempts at observing resonances in ^{233}U and ^{235}U are mentioned. (auth)

25675 FISSION FRAGMENT γ-RAY ANISOTROPIES. Kandil, A. T.; El-Mekkawi, L. S. (Atomic Energy Commission, Cairo (Egypt)); Holub, R. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). Nucl. Phys., A; 224: No. 3, 468-476(27 May 1974).

The anisotropy of fission fragment γ-rays in the reactions $^{239}Pu(n_{th},f)$ and $^{233}U(n_{th},f)$ have been measured. Two γ energy bands were used to confirm the energy independence of the anisotropy. For the γ energy band of 0.49–0.65 MeV and the γ energy band of 0.83–0.92 MeV the anisotropies were found to be 0.18 ± 0.03, 0.13 ± 0.03 and 0.19 ± 0.03, 0.11 ± 0.03, for the ^{239}Pu and ^{233}U targets respectively. The data are corrected for the Doppler effect and the time of flight was large enough to eliminate the counting of neutrons. Comparisons with the theories of Nix and Swiatecki, and Strutinsky have been made and approximate correction for fragment rotation along fission axis made. (auth)

25676 EFFECT OF THE OXIDATION STATE ON THE HALF-LIFE OF $^{235}U^m$. Neve de Mevergnies, M.; Del Marmol, P. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Phys. Lett., B; 49: No. 5, 428-430(13 May 1974).

The ^{235}U nucleus has a $\frac{1}{2}^+$ isomeric state decaying by an E3 transition to the $\frac{7}{2}^-$ ground state with a half-life of about 26 min. The transition has the exceptionally low energy of 73 ± 5 eV, and proceeds by internal conversion in the outermost electron subshells, most probably the $(6p_{\frac{1}{2}})^2$, $(6p_{\frac{3}{2}})^4$ and (6d) shells (or P-II, III and IV shells, resp.) of uranium. These shells, and consequently the isomeric decay rate, can be perturbed by changes in the valence electron subshells $(5f)^3(6d)(7s)^2$. The $^{235}U^m$ half-life in various chemical compounds of uranium has been measured. The half-life of $^{235}U^m$ in the +6 oxidation state is larger by (5.6 ± 1.1)% than that in the +4 oxidation state. (auth)

25677 TERNARY FISSION AND THE STABILITY OF SUPERHEAVY ELEMENTS. Schultheis, H.; Schultheis, R. (Tuebingen Univ. (F.R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 49: No. 5, 423-424(13 May 1974).

The barrier of ternary fission has been calculated for the superheavy nucleus $^{298}114$. Unlike actinide nuclei the barriers for binary and ternary fission are equal within 10%. (auth)

25678 ANGULAR MOMENTUM DEPENDENCE OF MOMENTS OF INERTIA AND FISSION BARRIERS OF ^{240}Pu. Mustafa, M. G. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy); Kumar, K. (Vanderbilt Univ., Nashville, Tenn. (USA)). Phys. Lett., B; 49: No. 5, 405-408(13 May 1974).

Minimization with respect to a constraint on angular momentum leads to a strong angular momentum dependence of nuclear properties. The second minimum of the potential energy surface of ^{240}Pu becomes lower than the first one for J > 24. (auth)

25679 INDICATIONS OF E2 ADMIXTURES IN THE ELECTRO-FISSION OF URANIUM. Kneissl, U.; Kuhl, G.; Weller, A. (Giessen Univ., (F.R. Germany). Strahlenzentrum). Phys. Lett., B; 49: No. 5, 440-442(13 May 1974).

The electro-fission of uranium has been investigated in the energy range from 15 to 40 MeV with electrons and positrons. Bumps in the cross-section ratio σ^-/σ^+ are explained as E2 admixtures after the onset of higher-chance fission. (auth)

25680 INVESTIGATION OF LRA FISSION OF ^{235}U BY NON-SHIELDED SEMICONDUCTOR TELESCOPE. Bayer, R. (Inst. of Nuclear Physics, Rez, Czech.); Cvanda, J.; Dlouhy, Z.; Kvitek, J.; Wilhelm, I. Czech. J. Phys.; 24: No. 7, 743-747(1974).

The energy spectrum of long-range alpha particles from ternary thermal neutron-induced fission of ^{235}U was measured. A nonshielded semiconductor telescope technique was used. The experimental spectrum was fitted by the Gaussian distribution with an average alpha energy of 15.65 ± 0.09 MeV and a full width at half maximum of 9.56 ± 0.10 MeV. (auth)

25681 STUDY OF NEUTRON ELASTIC SCATTERING ON HEAVY NUCLEI. Palla, G. (MTA Kozponti Fizikai Kutato Intezete, Budapest). Magy. Fiz. Poly.; 22: No. 2, 119-179(1974). (In Hungarian).

Measurements on the $^{238}U(n,\alpha n')$ and $^{238}U(n,n)$ reactions are discussed and an optical model analysis is given. (CES)

25682 ANGULAR ANISOTROPY OF THE FISSION OF ^{232}Th BY NEUTRONS DEEP BELOW THE THRESHOLD. Androsenko, Kh. D.; Smirenkin, G. N. (Physics and Power Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 6, 199-200(20 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 355-357(20 Mar 1974).

For the first time, the angular distributions of the fragments of the fission $^{232}Th(n,f)$ in the deep subbarrier neutron energy range 0.75–1.05 MeV were measured. The spectrum and quantum characteristics of the observed quasistationary states in the second well of the fissioning ^{232}Th nucleus, and the prospects for its further investigation, are discussed in light of the obtained data. (auth)

25683 THERMAL NEUTRON CAPTURE CROSS-SECTION AND RESONANCE INTEGRAL OF ^{227}Ac. Aly, H. F.; Herpers, U. (Univ., Cologne). Radiochem. Radioanal. Lett.; 18: No. 5, 259-265(21 Sep 1974).

The thermal-neutron capture cross section (σ_0) and the resonance integral (I_0) for the radioactive nuclide ^{227}Ac were measured by using the activation method. The amount of ^{227}Ac irradiated was evaluated from the rate of growth of the daughter ^{227}Th. Relative to ^{197}Au monitor, values of $\sigma_0 = 1020 \pm 39$ b and $I_0 = 2279 \pm 105$ b were obtained. (2 tables) (auth)

Nuclear Theory

Refer also to abstracts 24956, 25400, 25410, 25565, 25666, and 26138.

25684 (AED-Conf-74-042-003) PROPERTIES OF PADE APPROXIMANTS TO THE EFFECTIVE INTERACTIONS. Hofmann, H. M.; Richert, J.; Schucan, T. H. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany); Schweizerisches Inst. fuer Nuklearforschung, Villigen). 1974. 13p. INIS.

From conference on nuclear physics and high energy physics; Bochum, Germany (4 Mar 1974).

Some properties of Pade approximants to effective interactions in nuclei are investigated. The behavior of higher order approximants is discussed in model calculations. In the case of [2,1]-approximants a criterion is derived for the occurrence of spurious poles which are not related to level crossings. (auth)

25685 (JEN-282) AQUELARRE: A COMPUTER CODE FOR FAST NEUTRON CROSS SECTIONS FROM THE STATISTICAL MODEL. Guasp, J. (Junta de Energia Nuclear, Madrid (Spain)). 1974. 110p. (In Spanish). Dep. NTIS (US Sales Only) $8.50.

A Fortran V computer code for the Univac 1108/6 using the partial-statistical (or compound-nucleus) model is described. The code calculates fast-neutron cross sections for the (n,n'), (n,p), (n,d) and (n,α) reactions and the angular distributions and Legendre moments for the (n,n) and (n,n') processes in heavy and intermediate spherical nuclei. A local optical model with spin–orbit interaction for each level is employed, allowing for width fluctua-

tion and Moldauer corrections, as well as the inclusion of discrete and continuous levels. (4 figures) (auth)

25686 (JINR-E4-8029) ONE UNIVERSAL NUCLEAR CHARGE DENSITY DISTRIBUTION. Burov, V. V.; Eldyshev, Yu. N.; Luk'yanov, V. K.; Pol, Yu. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 13p. Dep. NTIS (US Sales Only) $4.00.

The symmetrized Fermi charge density distribution is suggested to analyze the nucleus-electron scattering form factors. It is shown to give a good agreement with the known experimental data both for light (beginning from ^{4}He) and for heavy (up to ^{208}Pb) nuclei at momentum transfers $q < q_0 \simeq 7.7\ A^{-\frac{1}{3}}\ fm^{-1}$. This result can obviously be explained by the correct realistic exponential behavior of the density distribution near and outside of the nuclear surface. (1 figure, 1 table) (auth)

25687 (JINR-P4-8001) PRE-EQUILIBRIUM DECAY OF NUCLEI IN PHOTONUCLEAR REACTIONS. Luk'yanov, V. K.; Seliverstov, V. A.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 25p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

It is shown that in preequilibrium decay of nuclei in photonuclear reactions the processes of coherent excitation of the dipole giant resonance levels play a very important role. (4 figures) (auth)

25688 (JINR-P4-8101) NEW METHOD FOR SEPARATING THE CENTRE OF MASS MOTION OF CLUSTERS IN NUCLEI. Kadmenskii, S. G.; Stratan, G.; Furman, V. I.; Kholan, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 21p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

A method is developed for separating the center-of-mass motion of a two-or-more-particle cluster moving in a Woods-Saxon potential. The particles forming the cluster can be identical or different. This method works for an arbitrary angular momentum of the internal motion of the cluster. (auth)

25689 (KFK-1748) STOCHASTIC PROCESSES OF A COLLECTION OF RADIOACTIVE CHAINS. Part II. Two-Dimensional Stochastic Processes of Radioactive Chains With Two Unstable States. Wenzelburger, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Datenverarbeitung und Instrumentierung). Apr 1974. 136p. (In German). Dep. NTIS (U. S. Sales Only) $10.00.

A collection of ν identical atoms (nuclides) having the same initial states, E_0, and decaying independently of one another in the course of time to the end states, E_μ, according to the chain $E_0 \xrightarrow{\lambda_0} E_1 \xrightarrow{\lambda_1} \dots \xrightarrow{\lambda_{\mu-2}} E_{\mu-1} \xrightarrow{\lambda_{\mu-1}} E_\mu$ is considered, λ_i being the decay constant of the state E_i ($i = 0,1,\dots,\mu-1$). In general, this collection is described by a probabilistic model, which is a special case of the pure birth process. In such a model the number, ν, of nuclides is assumed to be very large. In this work this assumption is dropped, and a model for arbitrary ν is derived. Dependent on the choice of random variables, either Markovian or non-Markovian stochastic processes are obtained. The case of two unstable states ($\mu = 2$), is discussed in detail and the general case is studied in sufficient detail to reveal its structure. All essential results are deduced first with an "analytical method" and then with a "combinatorical method". The starting point for the analytical method is a system of infinitesimal transition probabilities for the corresponding random variables. The starting point for the combinatorical method is a known or easily computable probability distribution from which the wanted probability distributions can be obtained. It is believed that the model is not restricted to radioactive series decay. It may have applications, for instance, in the stochastic theory of service systems. (5 tables) (auth)

25690 (LBL-2928) NUCLEAR COLLISIONS WITH FRICTION. Tsang, C. F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 23p. (CONF-740646-3). Dep. NTIS $4.25.

From Nobel symposium on superheavy elements; Ronneby, Sweden (10 Jun 1974).

A theory of nuclear collisions where a frictional force is introduced explicitly from the beginning is worked out based on a macroscopic and leptodermous idealization. A solution of the problem is made by freezing all degrees of freedom but four: the distance between centers of the colliding nuclei, the angle of rotation of a line joining the centers, and the two angles measuring the spins of the nuclei. The condition for capture as a function of energy and angular momentum is discussed in detail. Results on the kinetic energy and angle distributions of collision products are also obtained. (5 figures) (auth)

25691 (LBL-2945) MACROSCOPIC ASPECTS OF HEAVY-ION REACTIONS. Myers, W. D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1974. Contract W-7405-eng-48. 21p. (CONF-740637-8). Dep. NTIS $4.25.

From international conference on reactions between complex nuclei; Nashville, Tennessee, USA (10 Jun 1974).

Some reasons were given for the sudden surge of interest in the macroscopic approach to heavy-ion reactions. Then a number of different ways were mentioned for dealing with the many degrees of freedom inherent to the problem. The discussion was continued largely in the framework of the one-dimensional models that have been most heavily treated. Various geometrical considerations that bear on these models were presented, and some of the applications to reaction and compound-nucleus-formation cross sections were mentioned. Then a number of reasons were given for the difficulty encountered in forming a compound system when heavier projectiles are used, and it was pointed out that a whole host of new phenomena are expected to occur. Some of these new effects are already being observed. They promise to provide information on nuclear viscous (or damping) forces, on various nuclear time constants, and on the nature of the mechanical and hydrodynamical behavior of the smallest (clearly composite) system. (19 figures) (RWR)

25692 STUDY OF DOUBLY EVEN SD-SHELL NUCLEI IN THE MULTI-CONFIGURATION-HARTREE-FOCK MODEL. P. 1. The Intrinsic Structure. Schmid, K. W.; Satpathy, L.; Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik; Bonn Univ. (F. R. Germany). Inst. fuer Theoretische Kernphysik). Z. Phys.; 267: No. 5, 337-344(May 1974).

1 fig.; 3 tabs.; 26 refs. With abstract.

A theory in the spirit of the Hartree-Fock (HF) model is formulated which takes into account general types of correlation effects. This theory, dubbed as Multi-Configuration Hartree-Fock (MCHF) model, makes use of a multideterminantal trial wave function. The intrinsic ground state wave functions obtained in this theory have been studied. Doubly even N = Z and N = Z + 2 nuclei in the sd-shell have been treated and the results have been compared against the HF-predictions. While the HF-approximation is found to be quite good for N = Z nuclei, correlations are found to play a strikingly significant role in the N = Z + 2 nuclei. (auth)

25693 STUDY OF DOUBLY EVEN SD-SHELL NUCLEI IN THE MULTI-CONFIGURATION-HARTREE-FOCK MODEL. P. 2. The Influence of Correlations on the Ground State Rotational Spectra. Schmid, K. W.; Satpathy, L. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik); Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik; Bonn Univ. (F. R. Germany). Inst. fuer Theoretische Kernphysik). Z. Phys.; 267: No. 5, 345-353(May 1974).

2 tabs.; 33 refs.

The effect of the generalized correlations contained in the Multi-Configuration-Hartree-Fock solution on the ground state rotational bands is studied by projecting out states of good angular momentum. The results show that those spectra are quite sensitive to correlations. For the N = Z + 2 nuclei, where correlations have been found to be significant, major improvements compared to corresponding Hartree-Fock spectra are obtained. Different effective forces have been used to illustrate that the conclusions are force independent. In most cases, the calculated excitation energies as well as the B(E2) transition values are in rather good agreement at least with the gross properties of the experimental data. (auth)

25694 EFFECTIVE QUADRUPOLE OPERATORS FOR THE SECOND HALF OF THE 2p-1f SHELL. Schmid, K. W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik); Do Dang, G. (Paris-11 Univ., 91-Orsay (France). Lab. de Physique Theorique et Hautes Energies). Z. Phys.; 268: No. 1, 65-73(May 1974).

6 tabs.; 15 refs.

The one body matrix elements of the effective quadrupole operator in the $2p_{\frac{3}{2}}1f_{\frac{7}{2}}$, $2p_{\frac{1}{2}}$ configurations have been calculated taking into account the renormalization effects due to excitations from the closed $1f_{\frac{7}{2}}$ shell. First and second order perturbations of the residual interaction as well as an infinite series involving one particle-one hole core excitations are considered. The results are used to calculate quadrupole moments of odd mass nuclei together with BE2 values between low-lying states. Agreements with experimental results, wherever known, are seen to be generally greatly improved. (auth)

25695 DELAYED PROTONS AS A TOOL FOR STUDYING NUCLEI. Karnaukhov, V.A. (Joint Institute for Nuclear Research, Dubna). Sov. J. Part. Nucl. 4: No. 4, 416-439 (Apr 1974).

The properties of known delayed-proton emitters and the methods for using delayed-proton emission to study nuclei are reviewed. Isotopes with Z>N and Z<N are treated separately. In the first case, a

superallowed β transition can occur to an isobaric analog state. Delayed-proton emitters yield information about the properties of these states. A statistical method for describing the emission has been worked out for relatively heavy proton emitters ($Z < N$). Analysis of the experimental data in this case yields information about the strength function for β decay. The fine structure of the proton spectra is examined. It is interpreted as resulting from statistical fluctuations, whose amplitudes depend on the level density. A method is described for determining the mass defects of isotopes from data on delayed protons. (auth)

25696 PROPERTIES OF PADE APPROXIMANTS TO THE EFFECTIVE INTERACTION. Hofmann, H. M.; Richert, J. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)); Schucan, T. H. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). Z. Phys.; 268: No. 3, 293-297 (Jun 1974).

3 figs.; 10 refs.

Some properties of Padé approximants to effective interactions in nuclei are investigated. The behavior of higher order approximants is discussed in model calculations. In the case of [2,1]-approximants a criterion is derived for the occurrence of spurious poles which are not related to level crossings. (auth)

25697 EXPANSIONS FOR THE SCATTERING WAVE FUNCTION AND RADIATIVE CAPTURE IN R-MATRIX THEORY. Cugnon, J.; Mahaux, C. (Physics Department, University of Liège at Sart Tilman, 4000 Liège 1, Belgium). Phys. Rev. C 10: No. 1, 4-11 (July 1974).

We derive several expressions for the scattering wave functions in the frame of R-matrix theory. Particular attention is paid to the one-channel situation and to the one-level plus constant background approximation. These results are then applied to the radiative capture process. In particular, we investigate the possible appearance, and the physical interpretation, of asymmetric resonance peaks and of zeros in the capture cross section. The contributions of the external and internal regions are both included. Finally, we show that the resonance parameters of the one-level plus constant background Breit–Wigner approximation are stable against variation of the boundary parameters, the values of which therefore remain largely arbitrary. Correspondingly, the validity of this approximation does not depend critically upon the choice of the boundary parameters. (auth)

25698 NEW PROJECTION METHOD AND GENERALIZED ROTATIONAL SPECTRUM. Warke, C.S. (Tata Institute of Fundamental Research, Bombay-5, India). Phys. Rev. C 10: No. 1, 418-421 (July 1974).

Lanczos's algorithm for the matrix eigenproblem is used to project out angular momentum (J) components from a given deformed intrinsic wave function, containing N different values of J. Using this method, it is proved that the low-lying energy spectrum of a nucleus obtained by using the wave functions projected from a deformed intrinsic state (Hartree-Fock, Hartree-Fock-Bogoliubov, or random-phase approximation) has a general form suggested by Bohr and Mottelson in their macroscopic approach, $E(J) = E(\beta) + \Sigma_i^{N-1} A_n(\beta)[J(J+1)]^n$. Expressions for $E(\beta)$ and $A_n(\beta)$ are derived. The first iteration gives Skyrme's formula for the nuclear moment of inertia. The above analytic form of $E(J)$ is exploited to deduce certain conclusions about the nature of the projected energy as a function of J. (auth)

25699 RELATION BETWEEN THE OPTICAL MODEL AND THE VALENCE MODEL OF E1 NEUTRON CAPTURE AT AND BETWEEN RESONANCES. Lane, A.M. (Theoretical Physics Division, United Kingdom Atomic Energy Authority, Harwell, Didcot, Berkshire, United Kingdom); Mughabghab, S.F. Phys. Rev. C 10: No. 1, 412-414 (July 1974).

We show that there are simple relations between the valence model of neutron capture and the optical model. These are derived without recourse to any particular formal framework. The relations show that the predictions of the valence capture model involve the full optical potential and that it is inadequate to use the real part alone. (auth)

25700 FORMULA FOR THE FLUCTUATION CROSS SECTION OF NUCLEAR REACTIONS AT LOW ENERGIES. Hussein, M.S. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. C 10: No. 1, 395-397 (July 1974).

An expression is derived for the total fluctuation cross section valid for the general case of any number of directly coupled open channels. In the limit when this number is very large, one recovers the familiar Hauser–Feshbach result for inelastic scattering. A different result emerges for the elastic case. Generally for many overlapping resonances

$$\frac{\sigma_{cc'}}{(2I+1)\pi\lambda_c^2} = \left(\frac{N-1}{N+1}\,\delta_{cc'} + 1\right)\frac{P_c\,P_{c'}}{\sum_{c''} P_{c''}}\,.$$ (auth)

25701 MASS PARAMETER IN NUCLEAR QUADRUPOLE MOTION. Haff, P.K. (University of Washington, Seattle, Washington 98105 and California Institute of Technology, Pasadena, California 91109); Wilets, L. Phys. Rev. C 10: No. 1, 353-365 (July 1974).

The self-cranked generator coordinate (SCGC) formalism described earlier for computing the mass parameter for collective nuclear motion is cast into a form containing no explicit reference to the Hamiltonian. The expression is then specialized to the nuclear model of deformed harmonic oscillators. The usual Gaussian overlap approximation is eschewed in favor of direct evaluation of the appropriate matrix elements. Exchange terms are handled by a diagrammatic technique. The validity of certain assumptions made in the derivation of the mass formula is tested numerically. The effects of pairing and of short-range Jastrow correlations are investigated. The SCGC mass parameter is computed for several $N = Z$ nuclei and found to be smaller than either the cranking or the irrotational values, if no correlations are included. The inclusion of short-range correlations is shown to lead to important changes in the value of the mass parameter. (auth)

25702 CONNECTED KERNEL METHODS IN NUCLEAR REACTIONS. II. REARRANGEMENT REACTIONS AND THE DISTORTED-WAVE SERIES. Redish, E.F. (Service de Physique Théorique, Centre d'Etudes Nucléaires de Saclay, BP No. 2-91190 Gif-sur-Yvette, France). Phys. Rev. C 10: No. 1, 67-71 (July 1974).

The newly developed connected kernel equations for N-body scattering are applied to the study of rearrangement reactions. An integral equation for the transition operator is obtained which has a connected kernel and whose inhomogeneous terms contain the standard distorted-wave Born approximation (DWBA) and two-step part. The two-step part is similar to the expression usually used for the calculation of two-step reactions but with a nonstandard prescription for the driving potentials. The difference comes about because of the off-shell transformation used to simplify the original connected kernel equations. A multistep DWBA series is generated and the conditions for its convergence are discussed. (auth)

25703 NEW TREATMENT OF THE ONE-PARTICLE CONTINUUM IN NUCLEAR REACTION THEORY. Barrett, R.F. (School of Physics, University of Melbourne, Parkville, Victoria 3052, Australia); Delsanto, P.P. Phys. Rev. C 10: No. 1, 101-108 (July 1974).

A new method is proposed for the treatment of the one particle continuum in nuclear reaction theory. The method comprises a matrix diagonalization technique similar to that used in the eigenchannel theory. However, in contrast to the eigenchannel theory, this method does not require the S matrix to be obtained in a diagonal form. It is shown that, by a relaxation of this requirement, a numerically much faster method of treating the one particle continuum can be developed. (auth)

25704 TREATMENT OF LARGE PERTURBATIONS OF THE HAMILTONIAN AND THE BOUNDARY CONDITIONS IN SCATTERING AND REACTION CALCULATIONS. Perez, R.B.; de Saussure, G. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 10: No. 1, 187-199 (July 1974).

On the basis of an integrodifferential equation which was derived in a previous work for the T matrix of nuclear reaction theory, we have developed a general formalism to treat large perturbations in both the Hamiltonian and the boundary conditions of a quantum mechanical system. As a result of this formalism, a set of first order differential equations, in terms of any of the physical parameters of the system, is given for the widths and poles of the collision U matrix. The technique is illustrated by the conversion of a set of R-matrix resonance parameters into its equivalent set of U-matrix widths and poles, which corresponds to the passage from the R-matrix boundary conditions to the complex, momentum-dependent boundary conditions associated with the Kapur–Peierls reaction formalism. The case of large perturbations of the Hamiltonian is illustrated by the calculation of the elastic and inelastic scattering cross sections in a strongly coupled two-channel system which was proposed by Tobocman and has been widely used as testing grounds for reaction theories. (auth)

25705 VARIATIONAL MANY-CHANNEL NUCLEAR REACTION FORMALISM. Tobocman, W. (Physics Department, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. C 10: No. 1, 60-66 (July 1974).

We present multichannel nuclear reaction formalisms based on the Schwinger and Kohn variational principles. Our formalisms seem somewhat simpler in form than those heretofore proposed. The necessity of using the entire set of asymptotic boundary conditions to constrain the trial wave function is stressed. We show how this may be done by employing the coupled integral equations formalism discussed by Baer and Kouri, Kouri and Levin, and by Tobocman. Several explicit expressions for the transition amplitude are presented which appear to provide a promising basis for doing many-body system scattering reaction calculations. (auth)

25706 MULTIPLE-SCATTERING THEORY AND THE RELATIVISTIC OPTICAL MODEL. Celenza, L.S.; Liou, M.K.; Liu, L.C.; Shakin, C.M. (Institute for Nuclear Theory and Department of Physics, Brooklyn College of the City University of New York,

Brooklyn, New York 11210). Phys. Rev. C 10: No. 1, 398-401 (July 1974).

It is shown how to construct Lippmann–Schwinger equations for the scattering of relativistic projectiles from nuclear targets. The method is based on the Blankenbecler–Sugar reduction of a covariant equation. Among other topics, we discuss the optical model, the relativistic impulse approximation, coupled channel equations, and inelastic scattering. (auth)

25707 MEAN EXCITATION ENERGIES IN THE NUCLEAR MUON CAPTURE. Cannata, F. (Department of Physics, Catholic University of America, Washington, D.C. 20017); Mukhopadhyay, N.C. Phys. Rev. C 10: No. 1, 379-382 (July 1974).

The parametrization of the total muon capture rates in terms of a mean nuclear excitation energy $\bar{E}'$, proposed in a recent letter of Christillin, Dellaflore, and Rosa-Clot (CDR), is examined. We show that this parametrizaton ignores the importance of the allowed transitions in light nuclei and fails to reproduce the experimentally observed trend of the T > giant resonance energy as a function of nuclear mass number. The removal of contributions due to higher multipoles in heavier nuclei aggravates this discrepancy. The failure of $\bar{E}'$, extracted by CDR, to correspond to physically meaningful nuclear excitation energies in heavier nuclei is attributable to the intrinsic arbitrariness in its definition, and to the over-simplifying assumption of the nuclear Hamiltonian to be a sum of kinetic energy and Wigner potential alone. A first-order improvement of the Primakoff approximation is discussed. (auth)

25708 IMPORTANCE OF COULOMB INTERACTION POTENTIALS IN HEAVY-ION DISTORTED-WAVE BORN-APPROXIMATION CALCULATIONS. DeVries, R.M. (Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627); Satchler, G.R.; Cramer, J.G. Phys. Rev. Lett. 32: No. 24, 1377-1379 (17 June 1974).

We have considered the six interaction potentials involved in distorted-wave Born-approximation (DWBA) calculations and find that the inclusion of Coulomb interaction potentials which are usually neglected improve heavy-ion predictions in two ways: (1) The difference between cross sections calculated in the post and prior representations is reduced to a few per cent, and (2) the energy dependence found in spectroscopic factors derived from standard DWBA calculations is removed. (auth)

25709 CORRESPONDING-STATES APPROACH TO NUCLEAR AND NEUTRON-STAR MATTER. Palmer, R.G.; Anderson, P.W. (Cavendish Laboratory, Cambridge, England). Phys. Rev. D 9: No. 12, 3281-3291 (15 June 1974).

The properties of nuclear matter and dense neutron-star matter are studied by an approach which largely avoids the microscopic assumptions of nuclear-matter theory. The method is empirical, employing an extended form of the law of corresponding states to deduce the properties of nuclear systems from those of laboratory substances such as helium. It is possible to predict the solidification pressure and density, the compressiblity, and the critical temperature of nuclear and neutron-star matter. As previously reported, a comparatively low solidification pressure is found for neutron-star matter, implying a solid core for most neutron stars. (auth)

25710 SPACE-TIME STRUCTURE OF HADRONIC COLLISIONS AND NUCLEAR MULTIPLE PRODUCTION. Gottfried, K. (CERN, Geneva, Switzerland, and Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850). Phys. Rev. Lett. 32: No. 17, 957-961 (29 Apr 1974).

Nuclear interactions at high energy are sensitive to the space-time structure of basic hadronic collisions. A model of this structure is proposed; it provides a parameter-free account of National Accelerator Laboratory and cosmic-ray emulsion data, which shows that the multiplicity of mesons produced in nuclei exceeds that in hydrogen by an energy-independent ratio remarkably close to unity. (auth)

25711 INTERACTION BETWEEN NEUTRONS AND NUCLEI IN UNIFIED MODEL OF DIRECT AND RESONANT NUCLEAR REACTIONS. Ol'khovskii, V. S. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 6, 889-895(Jun 1974). (In Russian).

A concrete variant is developed for extension of independent-particle ideas to a description of direct and resonant nuclear reactions by use of a variational method. The calculation scheme for the intermediate-resonance parameters and some numerical evaluations are presented. (auth)

25712 CALCULATION OF THE TWO-BODY CORRELATION FUNCTION FOR FERMION SYSTEMS. Fantoni, S.; Rosati, S. (Univ., Pisa, Italy). Lett. Nuovo Cim.; 10: No. 13, 545-551(27 Jul 1974).

A method is described which allows one to treat the ground-state configurations of systems consisting of an infinite number of fermions interacting via a two-body potential in complete analogy with the case of classical fluids. Applications can be made to the cases of nuclear matter calculations, liquid helium-3, and neutron stars. (JFP)

25713 SEMICLASSICAL TREATMENT OF BREAK-UP REACTIONS. Baur, G. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)); Pauli, M.; Trautmann, D. (Basel Univ. (Switzerland). Physikalisches Inst.). Nucl. Phys., A; 224: No. 3, 477-491(27 May 1974).

A semiclassical treatment for heavy ion transfer reactions into the continuum is presented in the sub-Coulomb energy region. The physically important case of the deuteron break-up is investigated as a specific example. The accuracy of the method is thoroughly investigated and it is shown that the semiclassical description is in very good agreement with the quantal (DWBA) calculations of these processes. A comparison of the semiclassical method with recent experiments is given and several model calculations are presented. (auth)

25714 MALLMANN CURVES AND VARIABLE MOMENT OF INERTIA MODELS FOR NUCLEI. Wood, J. L.; Fink, R. W. (Georgia Inst. of Tech., Atlanta (USA). School of Chemistry). Nucl. Phys., A; 224: No. 3, 589-595(27 May 1974).

The plot of R_J ($R_J = E_{J1} + |E_{21}+)$ against R_4, J = 6,8, . . . , provides a clear picture of the trends of nuclear (quasi) rotational behavior in doubly even nuclei. Plots are presented up to J = 16, based upon recent experimental data. Corresponding curves predicted by various variable moment of inertia (VMI) models are calculated within the framework of Mantri and Sood's formalism and a comparison is made with these (Mallmann) curves. The comparison clearly shows how well various VMI recipes can be fitted to the experimental data and permits a discussion of the contributing microscopic factors. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 24237, 24286, 24840, 24867, 25117, 25324, 25509, and 26326.

25715 (PB-227928/9) CALCULATED DOSE DISTRIBUTIONS FOR INITIAL EXPERIMENTS WITH THE SUPERCONDUCTING PION CHANNEL. Li, G. C.; Schwettman, H. A. (Stanford Univ., Calif. (USA). High-Energy Physics Lab.). Jul 1973. 29p. (HEPL-TN-73-1; NSF-RA/N-73-083). NTIS $4.50.

The ionization dose, the pion star dose, the total dose, and the biological equivalent dose distributions are calculated for various operating conditions of interest using the superconducting pion channel. The calculation is based on the Monte Carlo superposition of 202 random rays originating from three separate points in the target and traced through the channel system and into a water phantom for each of 60 converging pion beams. The variation in the pion star fraction (pion star dose/total dose) is explicitly indicated since this quantity indicates the uniformity in radiation quality within a large target volume when irradiated by pions. The 5 micro amp electron beam from the Stanford Mark 3 accelerator provides a dose rate of 8.6 rads/min in a small volume which is sufficient for early dosimetry and radiobiology experiments. (GRA)

25716 (PB-229284/5) SINGLE-SCATTERING TRANSPORT THEORY FOR SPHERICAL GEOMETRY. Mingle, J. O. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Aug 1972. 13p. (RB-72-41). NTIS $4.00.

A realistic model for use on radiation therapy calculations is the solid sphere. As a first approach to spherical geometry transport calculations the single-scattered contribution to the albedo is determined by a geometric approach. As an interesting consequence of the calculations a mathematically feasible but physically incorrect solution is observed. (auth)

25717 (SAND-74-5040) TRANSPORT OF ION DEPOSITED ENERGY BY RECOILING TARGET ATOMS. Brice, D. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 6p. (CONF-740819-1). Dep. NTIS $4.00.

From 4th international conference on ion implantation into semi-conductors and other materials; Osaka, Japan (26 Aug 1974).

A previous method for directly calculating the spatial distribution of energy deposition into damage or ionization for ions implanted into solid targets is extended to account for the energy transport by recoiling target atoms. The new calculations extend the applicability of the method to lower incident ion energies. Good agreement is obtained between experiment and theory by using the improved procedure. (2 figures) (auth)

25718 (UCID-15550) FORMULATION OF THE RADIATION TRANSPORT PROBLEM. Campbell, P. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1967. 19p. Dep. NTIS $4.00.

The basic equations underlying the calculation of radiation transport are introduced briefly. The discussion is confined to one dimension. Topics covered are: equivalent representations of the angular distribution, the limits of strong and weak interaction, and space and time dependence. (MHR)

25719 (USC-113P-57) INVARIANT IMBEDDING AND ORDER OF SCATTERING THEORY. Technical Report No. RB73-47. Bellman, R.; Poon, P. T. Y. (University of Southern California, Los Angeles (USA)). Dec 1973. Contract AT(04-3)-113. 26p. Dep. NTIS $4.25.

Order-of-scattering theory in transport processes and its computational aspects was investigated by Bellman, Ueno and Vasudevan, Bellman, Poon and Ueno, Fymat and Ueno, Poon and Ueno, and Mingle. However, the approaches so far either utilize the expansion of the relevant functions of multiple scattering theory in a power series of the albedo for single scattering, or make use of the resolvent kernel of the Fredholm integral equation of the source function. A detailed analysis of order-of-scattering theory is given, and it is shown that the particle-counting technique of invariant imbedding alone can provide the fundamental equations. Also the theory is generalized to take into account of inhomogeneity and anisotropy. (auth)

25720 ELASTIC ENERGY LOSSES OF CHANNELIZED IONS. Komarov, F. F.; Kumakhov, M. A. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.- Mat. Navuk; No. 2, 86-93(1974). (In Russian).

Calculating the elastic energy losses of channelized ions, in contrast to the model of Lindhard, is presented in a multi-region approximation. Cases of various potentials of the interatomic interaction are considered. The elastic energy losses show a non-monotonic dependence on the atomic number of the incident ions with the use of an interatomic interaction potential obtained on the basis of a Hartree–Fock model of the atom. (SJR)

25721 STOPPING POWER OF FAST PROTONS UNDER CHANNELING CONDITIONS. Dettmann, K.; Robinson, M.T. (Institut für Festkörperforschung der Kernforschungsanlage Jülich, 517 Jülich, West Germany). Phys. Rev. B 10: No. 1, 1-9 (1 July 1974).

For fast channeled protons the electronic stopping power S_e is investigated in an impact-parameter treatment, where, for single inelastic atomic collisions, the proton moves on a classical straight-line trajectory. The electrons of the crystal atoms are described by hydrogenlike wave functions. In the MeV-energy range, the Born approximation can be applied. An average over all impact parameters yields a mean electronic excitation energy per collision that is twice the binding energy. Using this average for each impact parameter separately, we obtain S_e, slowly varying and finite for close collisions and with a long-range part corresponding to distant collisions. The results are in good agreement with experimental data in Si and Ge. (auth)

25722 CALCULATIONS PERTAINING TO THE USE OF FAST ($\lesssim$50-MeV) NEUTRONS IN CANCER RADIOTHERAPY. Alsmiller, R.G. Jr.; Barish, J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Med. Phys. 1: No. 2, 51-57 (Mar 1974).

Calculated results are presented for a variety of neutron spectra incident on a tissue-equivalent phantom. The neutron spectra considered are those produced by 35- and 50-MeV deuterons in a thick beryllium target and by 67-MeV protons in a thick lithium target. Results are presented for the absorbed doses, LET spectra, cell-survival probabilities, OERs, and RBEs as a function of position in the phantom. The cell-inactivation calculations were carried out using the model of Katz et al. and parameters for T-1 kidney cells. In the case of incident neutrons from 35-MeV ^{2}H on Be, experimental and calculated absorbed-dose data are compared as a function of position in the phantom and are shown to be in good agreement. (auth)

25723 A METHOD FOR OBTAINING BODY CONTOURS USING AN ULTRASONIC SCANNER AND TRANSVERSE TOMOGRAMS. Hughes, M.; Sternick, E.S. (Section of Medical Physics, Department of Therapeutic Radiology, Dartmouth-Hitchcock Medical Center, Hanover, New Hampshire 03755). Med. Phys. 1: No. 2, 72-73 (Mar 1974).

A method is described for obtaining the body contours and delineation of selected internal anatomical structures, using transverse tomography in conjunction with ultrasonography. Such information regarding body contours is used for radiation therapy treatment planning and for detaining isodose plots of the body. (AIP)

25724 PHOTOELECTRIC CROSS SECTIONS FOR 72.1-keV X RAYS IN Al, Cu, Zr, Ag, Sn, Ta, Au, AND Pb DERIVED FROM A TOTAL ATTENUATION-COEFFICIENT MEASUREMENT. Gowda, R.; Sanjeevaiah, B. (Univ. of Mysore, Manasagangotri, India). Phys. Rev., A; 9: No. 6, 2569-2572(Jun 1974).

The photoelectric cross sections have been extracted from the total absorption cross sections. The total cross sections have been estimated by measuring the absorption in Al, Cu, Zr, Ag, Sn, Ta, Au, and Pb for 72.1-keV x rays resulting from the decay of ^{203}Hg. The scattering cross sections are taken from recent tabulated values of Veigele for subtraction purposes. The photoelectric cross sections are compared with the values interpolated from the theoretical results of (i) Schmickley and Pratt and (ii) Scofield. (auth)

25725 THE INFLUENCE OF THE ELECTRON SHELL ON THE STOPPING OF Li IONS IN SUBSTANCES WITH $1 \leq Z_2 \leq 74$. Pietsch, W. Koeln, Ger.; Koeln Univ. (1972). 37p. (In German). INIS.

6 figs.; 9 tabs.; 25 refs. with abstract in German. Available from the library of the Koeln Univ.

The stopping of Li ions of 840 keV has been investigated in 37 substances (predominantly boron compounds) using a method allowing direct determination of dE/dx with an accuracy of 1%. The electronic stopping cross-section per molecule has been determined for each substance for the energy range between 840 and 100 keV; in this range, the linearity of stopping cross-section to velocity, as stated in the theory of Firsov and Lindhard, is confirmed. The measured stopping cross-sections of the molecules are split up into those of the atoms. By this it is shown that the chemical bond can have a strong effect upon the energy loss. In spite of this, information can be obtained about the dependence of stopping cross sections upon the atomic number Z_2 of the target atoms. The experimental data deviate from theoretical data, sometimes by more than 50%. These deviations are

periodic in Z_2 and are similar to "Z_1 oscillations" observed in other experiments. These oscillations are due to the periodic structure of the atoms which are not considered in the theories based on the Thomas Fermi model. By modifying the Lindhard formula it is possible to describe the Z_1 and Z_2 oscillations numerically. This allows an interpretation of the non-linear dependence of stopping cross-sections on the velocity of the incident particle, which has been observed in other experiments. (GE)

25726 MEASUREMENTS TO THE BACKSCATTER AND TRANSMISSION COEFFICIENT OF POLYCRYSTALS AND TO THE ORIENTATIONAL ANISOTROPY OF THE BACKSCATTER COEFFICIENT AND OF THE SECONDARY ELECTRONS YIELD FOR ELECTRON BEAMS WITH ENERGIES FROM 9 TO 100 keV. Seidel, H. Muenster, Ger.; Muenster Univ. (1973). 68p. (In German). INIS.

The material and layer thickness dependence of the backscatter and transmission coefficient for electrons with energies from 9 to 100 keV was determined experimentally as well as, with the help of Monte Carlo calculations, theoretically. The range of primary electrons was compared with a theoretical "Bethe-range." Besides the angular distribution of backscattered electrons for primary electron incident angles from 0–80° was determined using Be, Al, Cu, Ag and Au scatterers. Finally, anisotropy effects were studied using Si, Ge and Au monocrystals. (GE)

25727 ESTIMATES OF ANGULAR AND ENERGY DISTRIBUTIONS OF IONS REFLECTED FROM A SINGLE CRYSTAL. Karpuzov, D. S. (Inst. of Electronics, Sofia). Phys. Status Solidi (b); 64: No. 1, 351-355(1 Jul 1974).

Ion reflection based on a two-target-atom model is considered. In this approximation simple estimates of the angular distribution for small sliding angles are obtained (with or without thermal vibrations of atoms). The energy spectra in this case are also discussed. (auth)

25728 CALCULATION OF ELECTRON TRANSPORT IN A SLAB. Evdokimov, O. B.; Yalovets, A. P. (Inst. for Electronic Introscopy, Tomsk, USSR). Nucl. Sci. Eng.; 55: No. 1, 67-75(Sep 1974).

A new calculation method of electron transport in a medium with boundaries has been developed. The method is based on the solution of the kinetic equation, written for the segments model in the continuous slowing down approximation. The distribution function is represented in the Fourier–Legendre expansion and the equation has been reduced to a system of recursive relations, which permit calculation of the expansion coefficients. The boundaries of the medium have been considered by introduction of a nonscattering medium into the space outside the slab which led to the dependence of the angular distribution function on the coordinate. The calculational results for the plane case are presented and comparisons of them with experimental data and with the calculations of other authors show good agreement. (auth)

25729 ANALYTIC X-RAY TRANSPORT THEORY FOR NUMERICAL COMPUTATION. Cole, R. K. Jr. (Sandia Labs., Albuquerque, NM). Nucl. Sci. Eng.; 55: No. 1, 76-84(Sep 1974).

A simple, analytic approximate theory has been developed for calculation of x-ray transport in one-dimensional Cartesian geometry. The form of the theory is particularly suited to numerical computation. Deposition and energy currents can be calculated in times comparable to those required by exponential mass-absorption codes, with accuracies comparing favorably with more sophisticated discrete ordinates or Monte Carlo calculations. Although the theory is presented in terms of x-ray transport, it should be applicable to any transport problem for which (a) scattering is not highly anisotropic, and (b) averaged cross sections may be defined for secondary particles. (auth)

25730 LIFETIME-AVERAGED CROSS SECTIONS FOR X-RAY TRANSPORT CALCULATIONS. Cole, R. K. Jr. (Sandia Labs., Albuquerque, NM). Nucl. Sci. Eng.; 55: No. 1, 85-88(Sep 1974).

The lifetime distribution for initially monoenergetic photons subject to relativistic Compton (Klein–Nishina) scattering is evaluated using an analog of neutron slowing-down theory. By using reasonable approximations to the energy dependence of photon cross sections, the distribution and the lifetime-averaged cros sections are evaluated in closed form. The averaged cross sections are useful when all once-or-more scattered photons from a given source energy must be treated as a single group. (auth)

25731 MEASUREMENT OF ENERGETIC PARTICLE FLUX ANISOTROPIES WITH A CLASS OF SPINNING DETECTORS. Roelof, E. C. (John Hopkins Univ., Silver Spring, MD). J. Geophys. Res.; 79: No. 10, 1535-1538(1 Apr 1974).

First, the corrections applicable to a single particle species being analyzed in a single mode and the results for weak anisotropies are given. Then the corrections to multiple species being analyzed in several priority modes are generalized. The general expression for the counting rates due to anisotropies of arbitrary form (strong or weak) is given for a single species and mode and for multiple species and modes. (MHR)

Radiation Protection Standards

Refer also to abstracts 23978, 24298, and 24384.

Radiation Source Calibration and Standardization

Refer also to abstract 25553.

25732 (NCRP-41) SPECIFICATION OF GAMMA-RAY BRACHYTHERAPY SOURCES. (National Council on Radiation Protection and Measurements, Washington, D. C. (USA)). 1 Apr 1974. 24p. NCRP Publications, Washington, DC $3.00.

Encapsulated gamma-ray therapy sources are being specified now in terms of activity of the radionuclide (usually in millicuries), in terms of the equivalent mass of radium (usually in milligrams), or in terms of the exposure rate at a specified distance in air from the source (usually in roentgens per hour at one meter). These specifications are discussed and recommendations are given. Data for selected gamma-ray sources, definitions, references, information on the NCRP, and list of NCRP reports are included. (MHR)

Shielding Calculations and Experiments

Refer also to abstracts 25865, 25874, 25928, 26026, and 26039.

25733 (CONF-721018-(Vol.4)) PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE ON REACTOR SHIELDING, PARIS, FRANCE, OCTOBER 9–13, 1972. Volume 4. (Organization for Economic Co-Operation and Development, 75-Paris (France); CEA, 75-Paris (France)). 1972. 150p. (In English and Russian).

Seven papers are included. Separate abstracts were prepared for six. (MHR)

For abstracts of individual papers see: 25507–25509, and 25734–25737.

25734 (CONF-721018-(Vol.4), pp 1191-1201) DATA ACTIVITIES OF THE RADIATION SHIELDING INFORMATION CENTER. Roussin, R. W.; Trubey, D. K.; Maskewitz, B. F. (Oak Ridge National Lab., TN). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The Radiation Shielding Information Center (RSIC) is involved in many data activities, with most emphasis being placed on nuclear cross section data. Through cooperation with various agencies, RSIC assists in improving the adequacy of basic evaluated cross section data and packages and distributes various types of data libraries useful in radiation transport analysis. The emphasis of the effort is on the improvement of calculational tools available to the shielding analyst. (auth)

25735 (CONF-721018-(Vol.4), pp 1249-1296) STATUS REPORT ON NUCLEAR DATA FOR SHIELDING CALCULATIONS. Dunford, C. (IAEA, Vienna); Froehner, F.; Howerton, R. J.; Ozer, O.; Schmidt, J. J.; Valente, S. 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The nuclear data requirements for shielding applications as contained in the most recent, first world-wide request list for reactor nuclear data measurements (RENDA 72) are reviewed. It then surveys the availability of neutron cross section and photon production data relevant to shielding in the major evaluated nuclear data libraries. A brief description of present and planned major evaluation efforts is given. Further information is presented on methods, both experimental and theoretical, for obtaining photon production data. The present knowledge of the prompt fission neutron spectra is discussed. (auth)

25736 (CONF-721018-(Vol.4), pp 1297-1314) SHIELDING CALCULATIONS WITH COMPUTER FILES OF NEUTRON DATA. Froehner, F. H.; Valente, S. (NEA Centre de Compilation de Donnees Neutroniques, Saclay, France). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Existing evaluated neutron data on the total, differential elastic scattering, (n,γ), (n,p) and (n,α) cross sections of C, Na, Cr, Fe and Ni are reviewed. Information on additional unevaluated data

is given which may be useful for shielding calculations, especially above 15 MeV. The problem of neutron windows is discussed in some detail and illustrated with recent ORELA data on iron. Finally, conversion codes for the three main files of evaluated data are reviewed. (auth)

25737 (CONF-721018-(Vol.4), pp 1324-1330) NUCLEAR DATA REQUIREMENTS FOR CALCULATING REACTOR SHIELDING. Abagyan, A. A.; Dubinin, A. A.; Suvorov, A. P. (Inst. of Physics and Power Engineering, Obninsk, USSR). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The problem of nuclear data requirements is considered and the fact that for shielding purposes it is important to know the total cross-sections and elastic scattering indicatrices with a high degree of accuracy is brought out. The approximate accuracy of the required cross sections for interaction between neutrons and nuclei is given and it is indicated that the nuclear data for the spectra of secondary gamma rays accompanying radiative capture, inelastic scattering and certain other processes involved in the interaction between neutrons and nuclei are both inadequate and insufficiently accurate. (auth)

25738 (CONF-721018-(Vol. 5)) PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE ON REACTOR SHIELDING, PARIS, FRANCE, OCTOBER 9–13, 1972. Volume 5. (Organization for Economic Co-Operation and Development, 75 – Paris (France); CEA, 75 – Paris (France)). 1972. 174p. (In English and Russian).

Nine papers are included. Separate abstracts were prepared. (MHR)

For abstracts of individual papers see: 25510, 25739–25745, and 25865.

25739 (CONF-721018-(Vol. 5), pp 1343-1361) ORNL BENCHMARK EXPERIMENT FOR NEUTRON TRANSPORT IN THICK SODIUM. Maerker, R. E.; Muckenthaler, F. J.; Clifford, C. E. (Oak Ridge National Lab., TN). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The description of an experiment performed at the Tower Shielding Facility (TSF) is presented which provides verification of cross-section accuracy for use in transport calculations of deep penetration of neutrons through 15 ft of sodium. Results of calculations of the experiment are presented which were obtained by using the MORSE multigroup Monte Carlo code to calculate the transport based on an early version of the ENDF/B-III cross-section set for sodium. Comparison of the calculations with experiment indicates that the total neutron leakage above thermal energies penetrating 15 ft of sodium can be calculated to within ~30% and neutrons penetrating up to 10 ft of sodium to within ~10%. (auth)

25740 (CONF-721018-(Vol. 5), pp 1362-1374) FAST NEUTRON SPECTRUM MEASUREMENTS IN SPHERICAL IRON ASSEMBLIES. Williams, J. G.; Goddard, A. J. H. (Imperial Coll. of Science and Tech., London). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Energy spectra of fast neutrons leaking from the surface of spherical iron shells have been measured by the time-of-flight method. Shell thicknesses of 5.08 cm and 14.60 cm have been used. An inner polythene moderating shell has been used in conjunction with the 14.60 cm iron shell. With moderator present systematic errors did not exceed ±10% over the energy range 1 keV to 1 MeV and without moderator over the range 20 keV to 2 MeV. Measurements have been compared with Sn transport calculations in 100 groups using ENDF/BI data. (auth)

25741 (CONF-721018-(Vol. 5), pp 1375-1387) EVALUATION OF NUCLEAR DATA AND COMPUTATIONAL METHODS FOR IRON AS A SHIELD MATERIAL. Malaviya, B. K.; Kaushal, N. N.; Becker, M.; Ginsberg, A.; Burns, E.; Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, NY). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Experimental and analytical investigations of fast neutron transport in iron are discussed from the point of view of checking differential nuclear data useful in reactor shielding. Time-of-flight measured fast neutron angular flux spectra from different positions and directions in a clean, homogeneous iron assembly are analyzed using multigroup transport calculations, continuous slowing down theory and differential data from standard files as input to the calculations. A critical assessment of cross-section data files for iron is presented. (auth)

25742 (CONF-721018-(Vol. 5), pp 1444-1458) COMPARISON OF NEW TRANSPORT CALCULATIONAL METHODS FOR REACTOR SHIELD DESIGN. Ganapol, B.; Herrnberger, V.; Paratte, J. M. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Three transport calculational methods were compared with respect to accuracy and computation time for two deep neutron penetration problems in water. These methods were a mixed integral transport method without inner iteration, an accelerated Monte Carlo method and an S_N bootstrapping technique. The results showed that compared to the S_N technique the mixed integral method is faster and the Monte Carlo method is comparable in computation time. (auth)

25743 (CONF-721018-(Vol. 5), pp 1459-1471) COMPARISON OF ONE- AND TWO-DIMENSIONAL DISCRETE ORDINATE CALCULATIONS WITH EXPERIMENTAL RESULTS. Fuse, T.; Yamaji, A.; Miura, T. (Ship Research Inst., Tokai). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Neutron transport studies in a water medium and in a cylindrical air duct in a water medium were performed. The calculations were carried out with neutron transport codes ANISN and PALLAS-SP for one dimensional spherical geometry, and also with PALLAS-CY program for two dimensional geometry. The experiments were performed in a water shield of a pool type reactor JRR-4. Measurements were made by activation method. The calculated results were converted to the reaction rates to compare with the experimental results of absolute values. The agreement between the calculation and experiment appears to be fair. (auth)

25744 (CONF-721018-(Vol. 5), pp 1472-1492) BENCHMARK DATA FOR HIGH ENERGY GAMMA PENETRATION. Bishop, G. B. (Univ. of Liverpool); Smitton, C.; Packwood, A. 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Benchmark data on the penetration of 6.13 MeV gammas through lead, iron and water have been obtained by experiment and calculation. The calculations were made using a Monte-Carlo code McGID and the experimental data was obtained using the ^{16}N facility at the LIDO reactor, A.E.R.E. Harwell. The output from a Scintillation Gamma Spectrometer system was analyzed using a newly developed unfolding code GAMAK. A design for an isotropic uniform disc source is presented. Details are given of a higher flux ^{16}N Radiation Facility under construction at the Universities Reactor Centre, Risley. (auth)

25745 (CONF-721018-(Vol. 5), pp 1493-1509) GAMMA-RAY TRANSPORT AT 6 AND 8 MeV. Johnson, W. R.; Thompson, W. L.; Risher, D. H.; Hassler, L. A.; Rogers, J. E. (Univ. of Virginia, Charlottesville). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Experimental gamma-ray transmission and albedo measurements have been made in beam-geometry for photon energies of about 6 and 8 MeV. Results for low and medium atomic number shields are in agreement with analytical predictions. However, for the combination of high energy photon and high-Z shield, experimental values of transmitted dose and albedo are higher than would be calculated using standard techniques. A Monte Carlo program has been developed which simulates the coupled transport of gamma rays and electrons. The results of the code indicate a significant contribution to transmitted dose and albedo from bremsstrahlung for the combination of high energy source gamma rays and high atomic number shields. (auth)

25746 THEORETICAL STUDY OF VALIDITY OF SCALE-MODELING FOR GAMMA-RAY ATTENUATION. Verser, F. A. Jr. Manhattan, KS; Kansas State University (1973). 168p. University Microfilms Order No. 74-6645.

Thesis (Ph. D.).

A large number of experimental programs have been conducted to evaluate the shielding provided by structures from fallout gamma radiation. Full-scale experiments are expensive and time consuming and could be simplified by performing model experiments. Application of the principles of the scaling theorem will result in an exact reproduction in a geometrically scaled model of the results inside a full-scale structure. However, in practice, it is impossible to satisfy the necessary premises of the scaling theorem and certain compromises must be made. The specific limitations and validity of scale modeling as a result of these compromises have never been established. Calculations were made on full-scale and model structures using an adjoint Monte Carlo code. Problems were run for the following geometries: a standard detector, an open basement, a basement with a 46 psf cover, a basement with an 89 psf cover, a blockhouse with 48 psf walls and a 50.2 psf roof, and a blockhouse with 144 psf walls and a 91.5 psf roof. (Diss. Abstr. Int., B)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 25399, 25696, 26324, and 26326.

25747 (DESY-74/21) DEFINITIONS AND SELECTED APPLICATIONS OF FEYNMAN-TYPE INTEGRALS. Tarski, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). May 1974. 20p. (CONF-740460-1). Dep. NTIS (US Sales Only) $4.00.

From conference on functional integration; London, UK (2 Apr 1974).

A review is given of work done on Feynman-type integrals, both of the rigorous work dealing with the foundations, and of the applications to specific problems. The integrals considered are in particular those characterized by the weight factor e^{iA}, where A is the action of the physical system. (JFP)

25748 (JINR-E2-7987) UNITARILY INVARIANT CONVEX FUNCTIONS ON THE STATE SPACE OF TYPE I AND TYPE III VON NEUMANN ALGEBRAS. Uhlmann, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

Properties of unitarily invariant convex functions, defined on subsets of positive linear forms of type I and type III W^*-algebras were investigated. Especially characterized are those pairs of positive linear forms f,g for which $\Psi(f) \leq \Psi(g)$ holds for every unitarily invariant convex function Ψ and in which case one calls f "more chaotic" than g. (auth)

25749 (JINR-E4-8039) POSSIBILITY OF CONTINUOUS TRANSITION FROM WAVE OPTICS TO GEOMETRICAL ONE. Ignatovich, V. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 9p. Dep. NTIS (US Sales Only) $4.00.

A new way for constructing nonspreading wave packets for unbound massive particles in nonrelativistic quantum mechanics is proposed. The packet dimensions are supposed to decrease with increasing energy of the particle, thus giving a continuous transition from the wave optics to geometrical one. A particle wave function in such a scheme is found to be singular. Equations for this function and some possible experimental applications are discussed. (auth)

25750 (NYO-3406-11) PHOTON ANALOGUE FOR THE EINSTEIN–ROSEN–PODOLSKY PARADOX. Technical Report No. 7. Nelson, M. R. (Princeton Univ., N. J. (USA)). 25 Nov 1968. Contract AT(30-1)-3406. 26p. Dep. NTIS $4.50.

The results of an optical, double-slit experiment to test the Einstein–Podolsky–Rosen paradox are reported. (LBS)

25751 SPATIAL DISPLACEMENT OF ELECTRONS DUE TO MULTIPLE TOTAL REFLECTIONS. Fradkin, D.M.; Kashuba, R.J. (Department of Physics, Wayne State University, Detroit, Michigan 48202). Phys. Rev. D 9: No. 10, 2775-2788 (15 May 1974).

A theoretical investigation is made of the spatial displacements of a Dirac electron which undergoes a series of total internal reflections from finite potential barriers of arbitrary smoothness. These displacements are analogous to the shifts observed for optical total reflection (the Goos–Hänchen effect). For an electron, the polarization states that are invariant to a single-reflection process are identified and the change in polarization for an arbitrary incident polarized state is determined. A calculation of longitudinal and transverse shifts is made for a double-reflection process from surfaces with a specified orientation. This calculation is based on a phase-shift analysis in which a localization form-invariance argument for the wave packet is used to determine both the eigenpolarization states of the double-reflection process and the relevant phase shifts. An unpolarized beam of electrons will be split spatially into these geometry-dependent eigenpolarization states. In general, it is found that the total spatial displacement of the wave-packet center for each eigenstate consists of two parts, each of which has longitudinal and transverse components. There is a common shift (dependent on the potential) which near critical reflection is of the order of the de Broglie wavelength, and a polarization-dependent shift (independent of the potential) that causes a split that is at most of the order of a Compton wavelength. There is no splitting for reflections between parallel surfaces. In principle, a macroscopically observable common shift shift can be produced through multiple reflections. (auth)

25752 PROPAGATION ON A SPACE-TIME LATTICE. Peters, P.C. (Battelle Seattle Research Center, 4000 Northeast 41st Street, Seattle, Washington 98105 and Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. D 9: No. 12, 3223-3228 (15 June 1974).

An energy–momentum relation is derived for particles propagating on a discrete space–time lattice, in analogy with quantum mechanics of a particle propagating on a crystal lattice. Although there is a preferred rest frame, the low–momentum limit of the energy–momentum relation is that of special relativity. It is shown that breakdown of special-relativistic dynamics occurs for an energy which is the geometric mean of the rest-mass energy and the energy associated with the lattice spacing. Taking the lattice spacing to be the Planck length $[(\hbar G/c^3)^{1/2} = 10^{-33}$ cm] leads to a breakdown energy of order 10^{19} eV for protons, within the realm of observation of ultra–high–energy cosmic-ray events. (auth)

25753 DYNAMICAL SYMMETRIES IN QUANTUM THEORY. Aronson, E.B.; Malkin, I.A.; Man'ko, V.I. (University of Colorado, Boulder). Sov. J. Part. Nucl. 5: No. 1, 47-67 (July 1974).

A review of the status of the theory of dynamical symmetries is presented. We discuss from the point of view of dynamical groups nonrelativistic and relativistic quantum systems such as the harmonic oscillator, the hydrogen atom, and an electron in a magnetic field. The concept of symmetry of equations is analyzed, as well as the question of invariants of quantum systems and the connection between integrals of motion and dynamical groups. In particular, the general premises are considered with nonstationary systems as examples. Dynamical groups in classical mechanics are discussed. Applications of the method of dynamical symmetries to various problems of theoretical physics are given. (auth)

25754 MAXIMAL KINEMATICAL INVARIANCE GROUPS OF SCHROEDINGER EQUATIONS WITH ARBITRARY POTENTIALS. Niederer, U. (Univ., Zurich). Helv. Phys. Acta; 47: No. 2, 167-172(1974).

The general potential-independent form of the maximal kinematical invariance groups of Schroedinger equations is determined. The problem of finding the invariance group for a given potential is reduced to solving a single equation containing the potential and the invariance transformations. For some of the most interesting potentials the invariance groups are given explicitly. (auth)

25755 REPRESENTATION THEOREM FOR QUANTUM LOGIC. Bugajska, K. (Silesian Univ. Katowice, Poland). Int. J. Theor. Phys.; 9: No. 2, 93-99(Feb 1974).

The main assumption of Varadarajan's version (Geometry of Quantum Theory, Vol. 1. Van Nostrand, Princetown, (1968)) of Piron's (Helvetica Physica Acta; 37: 439 (1964)) representation theorem for quantum logic, stating that the lattice under any finite element of the logic is a geometry of finite rank, is eliminated by means of more plausible assumptions, concerning the property of symmetry of the transition probability between pure states. It is also proved, that the quantum logic with symmetric transition probability is irreducible if it is completely irreducible. (auth)

25756 METHODS OF STATISTICAL PERTURBATION THEORY (A REVIEW). Apresyan, L. A. (Radiotechnical Inst., Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 2, 165-184(1974). (In Russian).

The subject is reviewed with considerable mathematical development. (42 references)

25757 SOME METAMATHEMATICAL ASPECTS OF THE HENSELIAN FIELDS THEORY. Serban, B. A. (Institutul de Matematica al Academiei Republicii Socialiste Romenia, Bucharest). Stud. Cercet. Mat.; 25: No. 10, 1449-1459(1973). (In Rumanian).

Using the model theoretic methods due to J. Ax, S. Kochen and Ju. L. Ershov, a necessary and sufficient condition for elementary equivalence of two Henselian fields of characteristic zero, having residue class fields of characteristic $p > 0$, and satisfying other two conditions, is given, and a generalized form of a well-known J. Ax–S. Kochen's Theorem is considered. (auth)

Quantum Field Theories

Refer also to abstracts 25329, 25353, 25408, and 25409.

25758 (DESY-74/29) FEYNMAN-TYPE INTEGRALS FOR SPIN AND THE FUNCTIONAL APPROACH TO QUANTUM FIELD THEORY. Tarski, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jun 1974. 53p. Dep. NTIS (US Sales Only) $5.75.

A construction of Feynman-type integrals for systems with spin is outlined. In particular, in case of fields with half-odd-integer

spin, one integrates over a space of pairs $\{\eta,-\eta\}$. While the problems of analysis are only briefly considered, those of geometry are treated in greater detail, and some ideas from the theory of symplectic manifolds are utilized. As a sequel to this construction, a preliminary set of axioms for quantized fields in functional form is suggested. (auth)

25759 (DESY-74/31) REPRESENTATION THEORY OF THE UNIVERSAL COVERING OF THE EUCLIDEAN CONFORMAL GROUP AND CONFORMAL INVARIANT GREEN'S FUNCTIONS. Grensing, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jun 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

A special realization is presented for the universal covering of the Euclidean conformal group. This group can be defined as a transformation group on the Euclidean version of compactified Minkowski space such that the action on this space coincides with the usual one of the Euclidean conformal group. The representations of the principal and complementary series are constructed and the intertwining kernels for the equivalent representations are derived. The connection between representation theory and conformal invariant quantum field theory is studied. To this end also the reduction of the tensor product of two representations of the supplementary series is given. (auth)

25760 (INIS-mf-1351) SOME ASPECTS OF THE ELECTRODYNAMIC BEHAVIOR OF MATERIAL SYSTEMS. de Goede, J. (Rijksuniversiteit Leiden (Netherlands)). 5 Jul 1974. 64p. INIS.

Starting from the general solution of the classical boundary-value problem for electromagnetic fields, formal extinction theorems for the incident electromagnetic field are derived which are applicable to any medium and are nothing but general identities. Introducing material equations, the true extinction theorem of the Ewald–Oseen type is then derived from these identities for linear, isotropic, homogeneous systems. The importance of surface effects arising from discontinuities in the material parameters is demonstrated. This treatment establishes the intimate connection between the classical boundary-value problem and the extinction theorem. Starting from a Hamiltonian describing nonrelativistic charged particles with spin, the conventional linear response theory to obtain the conductivity tensor of many-body system is reviewed. A projection operator is then defined which yields the correct expression for the transverse part of the conductivity tensor in terms of the transverse part of a current–current commutator correlation function with a modified propagator. Inverse extinction theorems in electrodynamics are derived from the conventional linear response theory for a material system to an external electromagnetic field. Such inverse extinction theorems can also be obtained directly from the phenomenological Maxwell theory. (auth)

25761 (JINR-E2-7998) ESSENTIALLY NONLINEAR ONE-DIMENSIONAL MODEL OF THE CLASSICAL FIELD THEORY. Faddeev, L. T.; Takhtadzhyan, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 27p. Dep. NTIS (US Sales Only) $4.50.

It is shown that the equation $u_{tt} - u_{xx} + \sin u = 0$ with boundary condition $u(x,t) \to 0 (\mathrm{mod}\ 2\pi)$ when $|x| \to \infty$, which describes the classical field with essentially nonlinear interaction, is a completely integrable Hamiltonian system. The obtained results are interpreted in terms of particles, associated with the field u(x,t). (auth)

25762 (JINR-P2-8022) QUANTUM ELECTRODYNAMICAL PROBLEMS ON THE SIGNAL VELOCITY. Shirokov, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 54p. (In Russian). Dep. NTIS (US Sales Only) $5.75.

Local commutativity of the electromagnetic fields is considered usually as the causality condition. But does it really provide that signals propagate from source to detector with velocity not exceeding c? It is shown that the signal velocity does not exceed c indeed if one takes such sources as external current or electron which is excited by external force and if one detects such local quantities as field intensity in a point or the coordinate of the electron of the atom-detector. This result is obtained in the frames of solvable and rather real models of the quantum electrodynamics. But a noncausal result is obtained if the electron momentum or energy is detected (while source is the same). And what is more, there exists such a sort of source which forces premature changes even in coordinate distribution of the detector electron. So the relativistic causality in the considered cases depends on properties of the concrete detectors and sources. The local commutativity alone does not exclude the possibility of superluminar velocity. (auth)

25763 ON THE EQUIVALENCE OF SCALING, LIGHT-CONE SINGULARITIES AND ASYMPTOTIC BEHAVIOUR OF THE JOST-LEHMANN SPECTRAL FUNCTION. Bruening, E.; Stichel, P. (Bielefeld Univ. (F. R. Germany). Abt. Theoretische Physik). Commun. Math. Phys.; 36: No. 2, 137-156(Apr 1974).

23 refs.

For a local amplitude a one-to-one correspondence is demonstrated between properly defined scaling, the leading light-cone singularity and the asymptotic behavior of the corresponding Jost-Lehmann spectral function in the sense of distribution theory. The cases of canonical and non-canonical scaling are considered. (auth)

25764 ASYMPTOTIC PERTURBATION EXPANSION IN THE $P(\phi)_2$ QUANTUM FIELD THEORY. Dimock, J. (State Univ. of New York, Buffalo (USA). Dept. of Mathematics). Commun. Math. Phys.; 35: No. 4, 347-356(Feb 1974).

14 refs.

In the $P(\phi)_2$ model it is proved that the perturbation series for the infinite volume Schwinger function $S(\lambda)$ are asymptotic in the limit as the coupling constant λ goes to zero. We also give conditions which imply smoothness of $S(\lambda)$ at arbitrary λ. (auth)

25765 LOCAL OBSERVABLES AND PARTICLE STATISTICS. Doplicher, S. (Instituto Nazionale di Fisica Nucleare, Rome (Italy); Rome Univ. (Italy). Instituto Matematico); Haag, R.; Roberts, J. E. (Hamburg Univ. (F. R. Germany). 2. Inst. fuer Theoretische Physik). Commun. Math. Phys.; 35: No. 1, 45-85 (Jan 1974).

19 refs.

Starting from the principles of local relativistic quantum theory without long-range forces, we study the structure of the set of superselection sectors (charge quantum numbers) and its implications for the particle aspects of the theory. Without assuming the commutation properties (or even the existence) of unobservable fields connecting different sectors (charge-carrying fields), one has a particle-antiparticle symmetry, an intrinsic notion of statistics for identical particles, and a spin-statistics theorem. Particles in "pseudoreal sectors" cannot be their own antiparticles (a variant of Carruthers' theorem). We also show how scattering states and transition probabilities are obtained in this frame. (auth)

25766 RENORMALIZATION OF FEYNMAN AMPLITUDES AND PARAMETRIC INTEGRAL REPRESENTATION. Bergere, M. C.; Zuber, J. B. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Service de Physique Theorique). Commun. Math. Phys.; 35: No. 2, 113-140(Jan 1974).

6 refs.

A new subtraction formula is presented to renormalize Feynman amplitudes written in Schwinger's integral representation. The subtractions are generated by an operator acting on the integrand, which not only depends on the total number of internal lines but is completely independent of the structure of the graph. This formulation is also valid for non-renormalizable theories and is shown to reduce to Zimmermann's R-operation for scalar theories. It satisfies in any case Bogoliubov's recursive formula and yields an explicit tool for actual computations of renormalized Feynman amplitudes with a minimal number of subtractions. (auth)

25767 GAUGE-INVARIANT SIGNAL FOR GAUGE-SYMMETRY BREAKING. Dolan, L.; Jackiw, R. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 9: No. 10, 2904-2912 (15 May 1974).

The effective potential is computed to order $\hbar$ in an Abelian gauge theory—scalar electrodynamics. The calculation is performed first in the ghost-requiring R_ξ gauges. The corresponding expression is derived from the unitarity Lagrangian and is seen to be a limit of the R_ξ-gauge answer. We discuss the gauge dependence of the effective potential and its minima in connection with spontaneous symmetry breakdown; and we interpret the unitarity computation to be the physically relevant one. (auth)

25768 FUNCTIONAL FORMULATIONS OF QUANTUM ELECTRODYNAMICS. Bui-Duy, Q. (Centre de Recherches Mathématiques, Université de Montréal, Quebec, Canada). Phys. Rev. D 9: No. 10, 2794-2805 (15 May 1974).

The Wick-Hori theorem is used to write the S matrix in the Feynman and Schwinger formulations in which virtual-photon effects and virtual-electron-positron effects are respectively taken into account to all orders in $e^2/\hbar c$. Physical amplitudes in the Feynman formulation are represented by a finite number of graphs containing the exact off-mass-shell particle-to-particle amplitudes of electron-positron processes. In the Schwinger formulation physical amplitudes are represented by an infinite number of graphs containing the exact off-mass-shell particle-to-particle amplitudes of photon processes. Functional representation of the Compton scattering is given, and its asymptotic behavior is discussed. The differential equations which interrelate the off-mass-shell particle-to-particle amplitudes are given in the Appendix. Problems related to divergences are not considered. (auth)

25769 OFF-SHELL AND ON-SHELL BEHAVIOR OF VERTEX FUNCTIONS. Menotti, P. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 9: No. 10, 2767-2775 (15 May 1974).

The off-shell and on-shell asymptotic behaviors of the three-point vertex function are examined for renormalizable theories with anomalous dimensions. A general argument based on the conformal-operator expansion is given, according to which the off-shell vertex function has the same asymptotic behavior as the on-shell vertex function if the field of minimal dimension related to the particle has dimension less than 2. If the dimension is larger than 2 the two asymptotic behaviors differ. This result is verified by an explicit calculation on a model with anomalous dimensions, and it is shown to be related to the occurrence of shadow singularities in a three-point function. A comparison with the different situation in superrenormalizable theories is given. (auth)

25770 QUANTIZATION OF A FIELD WITH MASS IN TWO-DIMENSIONAL EUCLIDEAN SPACE. di Sessa, A. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 9: No. 10, 2926-2932 (15 May 1974).

As an example of a new approach to field theory we quantize scalar and spinor massive free fields in two-dimensional Euclidean space. Two appropriate conjugate spaces are generated to replace momentum space. The massless limits of the field theories are discussed. (auth)

25771 THE THIRRING AND THE VENEZIANO MODELS. Tye, S.-H.H. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 9: No. 10, 2821-2839 (15 May 1974).

Motivated by the development of a relativistic string, we extend the Thirring model in two-dimensional space-time and solve for its Wightman functions. By conjecturing that the scale dimensions of the Thirring fields are the momenta squared in physical space, we are able to introduce a dimensional scale, the Regge slope α'. We interpret the Thirring fields to be constituent fields such that a physical hadron field is a product of appropriate Thirring fields. Then it follows that the vacuum expectation values (i.e., the integrand) in the Veneziano model become Wightman functions in our extended Thirring model. Throughout, emphasis is placed on the conviction that, for physically observable quantities, currents are more fundamental than constituent fields. (auth)

25772 SPONTANEOUS BREAKDOWN OF A NON-ABELIAN SYMMETRY. Matsumoto, H.; Umezawa, H.; Vitiello, G.; Wyly, J.K. (Department of Physics, University of Wisconsin—Milwaukee, Milwaukee, Wisconsin 53201). Phys. Rev. D 9: No. 10, 2806-2813 (15 May 1974).

The spontaneous breakdown of SU(2) symmetry is investigated for an isotriplet scalar field. In terms of the path-integral method the in-field transformations which induce the original SU(2) transformations of Heisenberg operators are identified. It is found that the algebra of in-field transformations shows quite different structure from the original one. It is shown that the discrepancy of two algebras in caused by an infrared contribution. (auth)

25773 NONPOLYNOMIAL ANHARMONIC OSCILLATOR. Patil, S.H. (Department of Physics, Indian Institute of Technology, Bombay-400 076, India). Phys. Rev. D 9: No. 10, 2789-2793 (15 May 1974).

It is shown that for a nonpolynomial anharmonic correction, of the form $\beta x^4/4(1 + ax^2)$, to the simple harmonic oscillator with $H = p^2 + x^2/4$, the perturbation series in β is convergent over a finite domain $|\beta| < a$. The energy eigenvalues have a two-sheeted structure with the cut extending from $\beta = -a$ to $\beta = -\infty$, and $\beta = -a$ is the accumulation point of singularities on the second sheet along real $\beta > -a$. An estimate for the perturbation series, using dispersion relations, is presented. (auth)

25774 GENERALIZED RECOIL THEOREM FOR SOFT QUANTUM EMISSION INCLUDING PHOTON-PAIR CORRELATIONS TO INFINITE ORDER IN THE COUPLING CONSTANT. Matsson, L. (Institute of Theoretical Physics, Fack, S-402 20 Göteborg 5, Sweden). Phys. Rev. D 9: No. 10, 2894-2904 (15 May 1974).

A generalized recoil theorem to arbitrary order in the coupling constant including photon-pair correlations is derived. The corresponding factorizable, (because of pair effects not completely exponentiable) radiative transition rate is valid for an arbitrary process with arbitrary many particles of arbitrary charge and mass. The theorem is first derived for spinless source particles and then generalized to particles with spin. (auth)

25775 REMARKS ON THE PHYSICAL DEGREES OF FREEDOM IN TWO-DIMENSIONAL ELECTRODYNAMICS. Willemsen, J.F. (Stanford Linear Accelerator Center, Stanford Universit, Stanford, California 94305). Phys. Rev. D 9: No. 12, 3570-3572 (15 June 1974).

A simple argument is advanced for how it happens that two-dimensional electrodynamics is a theory of massive spinless bosons. (auth)

25776 SOLVING EQUATIONS OF THE GELL-MANN-LOW AND CALLAN-SYMANZIK TYPE. Ward, B.F.L. (Stanford University, Stanford, Calfornia 94305). Phys. Rev. Lett. 33: No. 1, 37-41 (1 July 1974).

An examination is made of the dimensional analysis usually employed to solve the renormalization group equations for the asymptotic region. It is argued that, if this analysis is done systematically, one must in general add new inhomogeneous terms to the asymptotic equations even after invoking Weinberg's theorem to discard the (generalized) mass insertion term. These new inhomogeneities are entirely determined by the physical thresholds of the theory. They are shown to provide a natural explanation of Bjorken scaling in interacting field theories. (auth)

25777 POMERANCHUK SINGULARITY IN A REGGEON FIELD THEORY WITH QUARTIC COUPLINGS. Abarbanel, H.D.I. (California Institute of Technology, Pasadena, California 91109); Bronzan, J.B. Phys. Rev. D 9: No. 12, 3304-3312 (15 June 1974).

We employ the methods of the renormalization group to investigate the structure of Pomeron Green's functions near $l = 1$, $t = 0$ in a theory where only four-Pomeron couplings are present. When certain conditions on the renormalized couplings are met, the $l \to 1$, $t \to 0$ behavior of the theory is governed by free effective couplings (the theory is infrared free). In this situation the renormalized Pomeron trajectory is of the form $\alpha(t) = 1 + At + Bt/(\ln Ct)^3$ for $t > 0$, where A, B, and C are constants; the total cross section behaves as $\sigma_T(s) \sim \gamma_1 + \gamma_2/(\ln \ln s)^3$, with γ_1 and γ_2 positive. (auth)

25778 GAUGE AND GLOBAL SYMMETRIES AT HIGH TEMPERATURE. Weinberg, S. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 9: No. 12, 3357-3378 (15 June 1974).

It is shown how finite-temperature effects in a renormalizable quantum field theory can restore a symmetry which is broken at zero temperature. In general, for both gauge symmetries and ordinary symmetries, such effects occur through a temperature-dependent change in the effective bare mass of the scalar bosons. The change in the boson bare mass is calculated for general field theories, and the results are used to derive the critical temperatures for a few special cases, including gauge and nongauge theories. In one case, it is found that a symmetry which is unbroken at low temperature can become broken by raising the temperature above a critical value. An appendix presents a general operator formalism for dealing with higher-order effects, and it is observed that the one-loop diagrams of field theory simply represent the contribution of zero-point energies to the free energy density. The cosmological implications of this work are briefly discussed. (auth)

25779 NONPERTURBATIVE APPROACH TO THE ELECTRON-MUON MASS RATIO IN GAUGE THEORIES. Vinciarelli, P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 9: No. 12, 3456-3460 (15 June 1974).

A pole approximation to the Dyson-Schwinger equations for the fermion self-energy parts is proposed to investigate the consequences of dynamical symmetry breaking on the pattern of lepton mass generation in gauge theories. This approach finesses known difficulties, encountered by Georgi and Glashow, in attempts to calculate the perturbative electron-muon mass ratio in theories with elementary Higgs fields. Its self-consistency would imply, via an eigenvalue equation, the existence of ultraheavy gauge bosons. (auth)

25780 CURRENTS AND LOCAL GAUGE SYMMETRIES. de Wit, B. (Institute of Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 9: No. 12, 3399-3412 (15 June 1974).

The current-algebra properties of gauge field theories are investigated. First, we consider a unified gauge field model of strong, weak, and electromagnetic interactions, which is a natural extension of the σ model combined with the Weinberg-Salam model. The violation of CP invariance is forbidden, and isospin is only broken by electromagnetic interactions. The pion is possibly a pseudo-Goldstone boson, which picks up its mass from weak and electromagnetic interactions. In the physical gauge the weak axial-vector currents are not of the canonical form, thus invalidating the current-algebra hypothesis. However, further analysis based on generalized Ward-Takahashi identities shows that the divergence equations are not affected. Furthermore, we discuss in which case the partially conserved axial-vector current approximation can be justified. (auth)

25781 BOGOLIUBOV BOUNDARY CONDITION AND THE THEORY OF SHADOW STATES IN QUANTUM FIELD THEORY. Chiang, C.C. (Institute of Theoretical Physics, FACK, S-402 20 Göteborg 5, Sweden). Phys. Rev. D 9: No. 12, 3562-3563 (15 June 1974).

We present our observation that the theory of shadow states satisfies the Bogoliubov boundary condition. (auth)

25782 POSITIVITY RESTRICTION ON ANOMALOUS DIMENSIONS. Ferrara, S. (CERN, Geneva, Switzerland); Gatto, R.; Grillo, A. Phys. Rev. D 9: No. 12, 3564-3565 (15 June 1974).

Arguments of positivity and conformal invariance in the Gell-Mann-Low limit imply positive anomalies γ_N [γ_N = (scale dimension) - 2 - N] for the operators $O_{\alpha 1 \ldots \alpha N}$ ($N \neq 0$) which occur in the light-cone expansion of two currents. (auth)

25783 VACUUM POLARIZATION AND THE ABSENCE OF FREE QUARKS IN FOUR DIMENSIONS. Kogut, J. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850); Susskind, L. Phys. Rev. D 9: No. 12, 3501-3512 (15 June 1974).

We speculate that the mechanism of one-dimensional quantum electrodynamics for phohibiting quark production can be generalized to three-dimensional space. The important feature of one-dimensional gauge theories which trap quarks is that electric flux lines cannot spread out and can only end on a charge. The generalization to three dimensions involved dynamical nonlinearities which trap electric flux lines into tubelike configurations. It is suggested that the required nonlinearities arise in Yang-Mills theories of "colored" quarks. The large-scale properties of hadrons would be described by a stringlike model similar to the conventional dual model. (auth)

25784 SYMMETRY BEHAVIOR AT FINITE TEMPERATURE. Dolan, L.; Jackiw, R. (Laboratory for Nuclear Science, and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 9: No. 12, 3320-3341 (15 June 1974).

Spontaneous symmetry breaking at finite temperature is studied. We show that for the class of theories discussed, symmetry is restored above a critical temperature β_c^{-1}. We determine β_c by a functional-diagrammatic evaluation of the effective potential and the effective mass. A formula for β_c is obtained in terms of the renormalized parameters of the theory. By examining a large class of graphs, we show that the formula is accurate for weak coupling. An approximate gap equation is derived whose solutions describe the theory near the critical point. For gauge theories, special attention is given to ensure gauge invariance of physical quantities. When symmetry is violated dynamically, it is argued that no critical point exists. (auth)

25785 COMMENT ON A CLASS OF MANIFESTLY UNITARY GAUGES. Collins, J.C. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, England). Phys. Rev. D 9: No. 12, 3566-3569 (15 June 1974).

The advantages are pointed out of using a certain class of manifestly unitary gauges in theories of spontaneously broken gauge symmetry. These gauges are particularly useful in the recent theories of strong interactions. (auth)

25786 RAMIFICATIONS OF FLUX QUANTIZATION. Post, E.J. (University of Houston, Houston, Texas 77004). Phys. Rev. D 9: No. 12, 3379-3586 (15 June 1974).

The null results in the search for magnetic monopoles and the experimentation exhibiting dipolar flux quantization as obtained during the last two decades mildly invited a withdrawal from the Dirac-Schwinger symmetry hypothesis to the earlier position of an essentially asymmetric set of Maxwell equations. In this paper we attempt to account for the null result by a symmetry alternative that accommodates the persistence of this Maxwellian asymmetry. It is shown that a topological symmetry, more hierarchal in nature, can comply with the absence of magnetic monopoles. This alternative then places the law of flux conservation on the same fundamental footing as the law of conservation of electric charge. The ensuing law statements are now global in nature and correspondingly stronger in content than the traditional local statements. The physical implications of these global conservation statements are examined in relation to the existing observational evidence of dipolar flux quantization. (auth)

25787 STRAIGHT-LINE PATH APPROXIMATION IN QUANTUM FIELD THEORY. Kuleshov, S.P.; Matveev, V.A.; Sisakyan, A.N.; Smondyrev, M.A.; Tavkhelidze, A.N. (Joint Institute for Nuclear Research, Dubna). Sov. J. Part. Nucl. 5: No. 1, 1-24 (July 1974).

The aim of this review is to acquaint the reader with the basic ideas and elements of the mathematical apparatus on which the straight-line path approximation in quantum field theory is based. A number of applications of the approximation to the interaction of high-energy particles are considered and its connection with the quasipotential description in quantum field theory is considered. (auth)

25788 NONLOCAL QUANTUM ELECTRODYNAMICS. Efimov, G.V. (Joint Institute for Nuclear Research, Dubna). Sov. J. Part. Nucl. 5: No. 1, 89-102 (July 1974).

Nonlocal quantum electrodynamics is examined. The axioms for the quantum theory of interacting electro-magnetic and electronic fields are formulated. An S matrix is constructed which satisfies unitarity, causality, covariance, gauge invariance, and which is finite to all orders of perturbation theory. This nonlocal theory describes the interactions of a local electromagnetic field with an extended electron which has the shape of a sphere of radius l. (auth)

25789 EXTENDED NONPERTURBATIONAL CALCULATION OF THE RESONANCE SHIFT IN SEMI-CLASSICAL AND QUANTUM APPROACHES. Oliver, G. (Faculte des Sciences, Orsay, France). Lett. Nuovo Cim.; 10: No. 13, 561-564(27 Jul 1974).

It is shown that the calculation of the analytical expression of the density matrix elements of a two-level quantum system interacting with an intense monochromatic electromagnetic field can be performed in the semiclassical and quantum approaches in very similar ways. Particularly the diagonalization of the Hamiltonian matrix is common to the two approaches. It is concluded that the matrix method approach can be used to solve quite cumbersome problems. (JFP)

25790 RENORMALIZED EIKONAL PERTURBATION THEORY FOR MASSIVE QUANTUM ELECTRODYNAMICS. Orzalesi, C. A. (Parma Univ. (Italy). Instituto di Fisica). Phys. Lett., B; 49: No. 5, 451-454(13 May 1974).

A renormalizable eikonal perturbation theory is derived for massive quantum electrodynamics. The renormalization is explicitly carried out in lowest order. (auth)

25791 SYSTEMATIC ERROR FROM NONLINEAR LEAST SQUARES COMPUTER FITTING OF LORENTZIAN LINES. Pfeiffer, L.; Lichtenwalner, C. P. (Bell Telephone Labs., Inc., Murray Hill, NJ). Rev. Sci. Instrum.; 45: No. 6, 803-808(Jun 1974).

It is shown using Monte Carlo methods that serious systematic error may be introduced in the nonlinear least-squares (NLLSQ) fitting of Lorentzian line spectra of poor statistical quality or with too few data points in the lines. For such spectra it was found that the NLLSQ estimates of Lorentzian linewidth error are unreliable. This has the result of causing the weighted mean linewidth from several similar spectra to be unequal to the result obtained by adding the spectra together channel by channel and then doing the NLLSQ fit. The problem is illustrated using examples from Moessbauer spectroscopy, however, the results appear to be quite generally relevant in all cases where statistically marginal data are fit with Lorentzian lines. (auth)

25792 CONFORMAL INVARIANT BOOTSTRAP FIELD THEORY. Mack, G. (Univ., Bern). Ann. N. Y. Acad. Sci.; 229: 17-27(20 May 1974).

The construction of conformal invariant field theory using the bootstrap approach is discussed. Only strong interactions are considered, allowing for weak and electromagnetic ones only to lowest order. The renormalized Schwinger-Dyson integral equations for the dressed propagator and dressed 3-point vertex are used in the bootstrap approach. For the higher $N \geq 4$ point Green's function, skeleton graph expansions are used. The argument for ultraviolet convergence of the skeleton graphs is presented. Other topics discussed are: other local fields; ϕ^3 theory in $D = 6 + \epsilon$ space-time dimensions; and non-Bjorken scaling. (LBS)

25793 REGGEIZATION OF NON-ABELLIAN GAUGE VECTOR MESONS: S-MATRIX THEORY VERSUS FIELD THEORY. Schnitzer, H. J. (Brandeis Univ., Waltham, MA). Ann. N. Y. Acad. Sci.; 229: 45-52(20 May 1974).

Arguments are presented that lead to the conclusion that elementary non-Abelian gauge vector mesons of renormalizable Yang-Mills theories lie on Regge trajectories, independent of the free parameters of the model. (LBS)

25794 BILOCAL THEORY OF QUANTUM ELECTRODYNAMICS. Katayama, Y. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 4, 1430-1431(Oct 1973).

It is shown that the bilocal electron and photon fields give a consistent gauge invariant theory. (JFP)

25795 QUANTIZATION OF THE KLEIN-GORDON FIELD IN SPHERICALLY SYMMETRIC EINSTEIN SPACE-TIMES. Blum, B. S. Waltham, MA; Brandeis Univ. (1974). 68p. University Microfilms Order No. 74-16,809.

Thesis (Ph. D.).

The uncharged Klein-Gordon field in a spherically symmetric background geometry is quantized. The geometry is described from the viewpoint of differential topology, and the classical equation of motion of the Klein-Gordon field is derived in a geometrical, coordinate invariant manner. This is done first in a manifestly covariant way using an action principle, and then through the use of Poisson brackets as a basis for the quantum theory. A restriction is made to the Schwarzschild sector of the maximal Kruskal manifold so that the time-like Killing field possessed by the Schwarzschild manifold may be exploited. The field equation is separated in Schwarzschild coordinates and analyzed. Two asymptotic regions, one at spacial infinity and one at the Schwarzs-

child radius, are shown to exist. The eigenvalue problem is discussed and it is shown that the problem is self-adjoint, having a complete, orthogonal set of eigenfunctions. Canonical quantization is performed by imposing the usual quantum conditions on the classical Poisson brackets. Using the time-like Killing field, the Klein–Gordon field is decomposed into positive and negative frequency states, and a vacuum state is defined. A Fock space is constructed and it is shown that there is no creation or loss of particles, either in the Schwarzschild manifold or at its boundaries. An alternative algebraic quantization procedure due to Segal is presented which leads to equivalent results in the Schwarzschild manifold, but which shows promise of being useful in the extension of these results to the Kruskal manifold. The scattering operator which takes states from past infinity (Schwarzschild time) to future infinity is defined and the particle interpretation of these states is discussed. Finally the entire Kruskal manifold is considered. It is shown that the condition that the field be regular at all nonsingular points of the manifold leads to a boundary condition that the field be static at the Schwarzschild radius. This boundary condition is shown to ensure the existence of the various integrals in the theory. Speculation is then made as to how the extension of the quantization to the Kruskal manifold may be effected using the algebraic apparatus previously developed. (Diss. Abstr. Int., B)

Gravitation and General Relativity

Refer also to abstract 25064.

25796 (IFVE-STF-73-42) ZERO VALUE OF THE SCHWARZSCHILDIAN MASS OF ASYMPTOTICALLY EUCLIDEAN TIME-SYMMETRICAL GRAVITATIONAL WAVES. Folomeshkin, V. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 12p. (In Russian). INIS.

It is possible to select a system of coordinates with simple coordinate conditions in which the Schwartzschild mass of an asymptotically Euclidean system of gravitational waves is equal to zero. A system of counting was examined, and the equation of the gravitational field was written explicitly. (tr-auth)

25797 (IFVE-STF-73-50) EQUALITY TO ZERO OF SCHWARZSCHILDIAN MASS OF ARBITRARY, ASYMPTOTICALLY EUCLIDIAN SYSTEM OF GRAVITATIONAL WAVES. Folomeshkin, V. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 16p. (In Russian). INIS.

A system of coordinates can be selected in which it will be clearly seen that the Schwarzschild mass of a random, asymptotically Euclidean system of gravitational waves equals zero. It is sufficient that the two conditions be fulfilled. In a t-orthogonal metric these conditions have simple forms. From this equation it is found that, for asymptotic Schwarzschild metrics, $m = 0$ if $T_1^1 = 0$. (tr-auth)

25798 (RL-74-038, pp VIII.1-VIII.16) GRAVITATIONAL WAVE EXPERIMENTS. Drever, R. W. P. (Univ. of Glasgow). Mar 1974.

An attempt is made to give some impression of the nature of gravitational radiation. Some of the experiments done in this field, or now in progress, are described. An attempt is made to give a picture of the present situation, with some speculations about the future. (LBS)

25799 NOTE ON SPACE-TIMES THAT ADMIT CONSTANT ELECTROMAGNETIC FIELDS. Eardley, D.M. (California Institute of Technology, Pasadena, California 91109). J. Math. Phys. (N.Y.) 15: No. 8, 1190-1191 (Aug 1974).

All space-times that admit a covariantly constant, test, electromagnetic field are constructed. All solutions to the Einstein–Maxwell equations with constant electromagnetic field are given. (auth)

25800 GRAVITATION AND MAGNETIC CHARGE. Kurşunoğlu, B. (Center for Theoretical Studies, University of Miami, Coral Gables, Florida 33124). Phys. Rev. D 9: No. 10, 2723-2745 (15 May 1974).

Based on the static spherically symmetric solutions of the generalized theory of gravitation it is found that electric and magnetic charges are two fundamental constants of integration and that the corresponding electric, magnetic, and gravitational fields are regular everywhere only if the magnetic charge $g \neq 0$ ($\sim 10^{19}e$). For magnetic charge $g = 0$, the solutions reduced to the Nordström solution of general relativity in the limit of large r. The theory leads to elementary particles of finite self-energy $[\Delta(\pm E) = mc^2 - (2g_0)^2/l_0]$ and binding energy. The structure of an elementary particle which is due to the existence of finite $\pm g$ consists of a magnetically neutral core of matter containing a distribution of magnetic charge density in stratified layers of sharply decreasing magnitude and alternating signs so that magnetic monopoles associated with a long-range field do not exist. As a consequence of the general covariance of the theory the surfaces of zero magnetic charge density in the particle core have an indeterminacy. These facts lead to a mass spectrum for elementary particles. In addition to charged electric and magnetic currents, the theory yields an electrically neutral current and the corresponding fields. The neutral current and the corresponding neutral field are the classical counterparts of the vacuum polarization in quantum electrodynamics. For every positive-energy solution there exists also a negative-energy solution with the corresponding electric charge. For $g = 0$, the volume integral of the neutral current density diverges. The asymmetry of Maxwell's equations with regard to the absence of a magnetic current can be understood because the neutral and charged magnetic currents and the neutral part of the electric current are localized in the core of the elementary particle. Furthermore, the theory yields two lengths of the dimensions of 10^{-25} and 10^{-15} cm which could serve to differentiate between leptonic and hadronic processes. The presence of negative-energy solutions along with positive-energy solutions points to a large-scale symmetry with respect to a distribution of matter and antimatter in the universe. (auth)

25801 INVARIANT NONCANONICAL MAPPINGS OF SINGULAR THEORIES. Bergmann, P.G. (Physics Department, Syracuse University, Syracuse, New York 13210); Komar, A. Phys. Rev. D 9: No. 12, 3301-3303 (15 June 1974).

We extend to theories with constraints an earlier result which related noncanonical invariant mappings of classical trajectories in phase space to conserved quantities. In particular we show that the associated constants of the motion may be expressed in a form identical to those of nonsingular theories, making no explicit reference to the constraints, or to gauge or coordinate conditions. (auth)

25802 EQUATORIAL CIRCULAR ORBITS OF SOME STATIC GRAVITATIONAL FIELDS WITH NAKED SINGULARITIES. Liang, E.P.T. (Department of Physics, University of Utah, Salt Lake City, Utah 84112). Phys. Rev. D 9: No. 12, 3257-3262 (15 June 1974).

We investigate the equatorial circular orbits in the Weyl metrics with naked singularities. We find that in many Weyl fields, as well as in the Reissner–Nordström $e > m$ metric, there are equatorial equilibrium regions corresponding to large gravitational red-shifts at infinity. However, except in the Reissner–Nordström case, such regions are unstable. Thus these solutions might not be very realistic models of large-red-shift objects. On the other hand, it is likely that there may be gravitational-synchrotron-radiation orbits in the Weyl metrics. These and other properties of naked singularities indicate that they should be studied more closely for possible roles in exotic astrophysical phenomena. (auth)

25803 NUMERICAL INTEGRATION OF EXACT TIME-DEPENDENT EINSTEIN EQUATIONS WITH AXIAL SYMMETRY. I. Pachner, J. (Univ. of Saskatchewan, Regina). J. Comput. Phys.; 15: No. 3, 385-412(Jul 1974).

The complete system of exact equations describing a nonstationary state of an axially symmetric relativistic object consisting of a perfect fluid is reduced to the form suitable for the numerical integration by a computer. It is assumed that all the thermodynamic processes are adiabatic and no nuclear energy is being released, but no restriction is imposed on the analytically expressed equation of state. By this method it is possible to compute the initial data and the time evolution of the interior and exterior field generated either by a single rotating and contracting (or expanding) body or by two neutron stars before and during their head-on collision. (auth)

25804 THE MOTION, IN THE DRIFT APPROXIMATION, OF A RELATIVISTIC CHARGED PARTICLE IN A STRONG MAGNETIC FIELD. Mangeney, A. (Observatoire de Paris, Section de Meudon, 92 (France). Lab. d'Astronomie Spatiale); Signore, M. (Observatoire de Paris, Section de Meudon, 92 (France)). Phys. Lett., A; 48: No. 1, 65-67(20 May 1974).

The Witham's averaged Lagrangian technique is applied to derive (in terms of drifts and transverse adiabatic invariant) the motion of a relativistic particle, in a strong magnetic field. (auth)

25805 STATIONARY CHARGED DUST DISTRIBUTION IN AXIALLY SYMMETRIC FIELDS. Misra, R. M.; Pandey, D. B.; Srivastava, D. O. (Univ. of Gorakhpur, India). Proc. Indian Nat. Sci. Acad., Part A; 39: No. 3, 132-136(May 1973).

The Einstein–Maxwell equations for an axially symmetric stationary gravitational field are investigated. The space is assumed to be filled with charged incoherent matter. It is shown that if the Lorentz force vanishes everywhere, the charge density bears a constant ratio to the mass density, and this constant ratio may assume arbitrary values. (auth)

25806 PLANE GRAVITATIONAL CONDENSOR WITH THE POSITIVE GRAVITATIONAL CONSTANT. Novotny, J.; Horsky, J. (Univ., Brno). Czech. J. Phys.; 24: No. 7, 718-724(1974).

The equations of motion for the plane shell consisting of an ideal fluid and creating the de Sitter solution on one side and the static plane symmetric solution of Einstein equations with positive cosmological constant on the other side are derived. The solution of the equation of motion for the case of the "plane gravitational condensor" is found, and the necessary agreement with the solution of the problem in the case $\Lambda = 0$ is demonstrated. (auth)

25807 GENERAL RELATIVISTIC VARIATION PRINCIPLE FOR FLUIDS AND SOLIDS IN EULERIAN COORDINATES. Salie, N. (Friedrich-Schiller Univ., Jena, Ger.). Czech. J. Phys.; 24: No. 8, 831-845(1974). (In German).

The basic equations of the general relativistic continuum mechanics are derived in Eulerian coordinates by a variational principle with subsidiary conditions. For liquids and solids the Einsteinian field equations with the attached energy-momentum tensor and the adequate equations of motion for the mechanical and thermodynamical quantities follow. The subsidiary conditions are, on the one hand, physical requirements for system and processes (reversibility, particle conservation), and on the other hand, consequences of definitions (normalization of velocity). Lin's principle of the identity of particles is discussed. It is necessary as a subsidiary condition. (auth)

25808 TRANSMISSION AND REFLECTION OF ACOUSTIC GRAVITY WAVES FROM TRAVELING DISCONTINUITIES. Grigor'ev, G. I. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 5, 796-799(1973).

Translated from Geomagn. Aeron.; 13: No. 5, 938-939(1973).

The statement of the problem of the calculation of the coefficients of reflection and transmission of acoustic gravity waves from traveling discontinuities is as follows: A shock wave moves vertically upward at velocity v in an isothermal plane-stratified atmosphere with a homogeneous gravity field. Since the size of the transition discontinuity region amounts to several mean free paths of the particles, and the characteristic scale of change of the properties of the medium (scale height of the atmosphere) substantially exceeds l_{fr}, the shock wave parameters may be determined with sufficient accuracy from formulas established for homogeneous media. (JFP)

REACTOR TECHNOLOGY AND REGULATION

25809 (NP-20064) ANNUAL REPORT, 1973. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). 30 Apr 1974. 74p. (In German). Dep. NTIS (US Sales Only) $6.75.

The organization of the EIR and its primary objectives are briefly outlined. The studies made in the areas of reactor development, teaching, chemistry, electronics, hot cells, isotope production, metallurgy, and physics are indicated. A list of publications and patents for the year is included. (JSR)

25810 (RDT-INDEX-7-74) INDEX OF RDT STANDARDS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Jul 1974. 50p. RSO.

25811 CONCENTRATION ON FUEL CYCLE. Standardization of Nuclear Power Plants Could Shorten Licensing Procedures. Lenz, W. VDI (Ver. Deut. Ing.) Nachr.; 28: No. 21, 12(May 1974). (In German).

From reactor meeting; Berlin, F. R. Germany (2 Apr 1974). 1 fig.

Important development trends discussed at the 1974 reactor conference in Berlin included the field of standardization, licensing procedures, technical and economical problems of the fuel cycle, and further development of the fast breeder and high-temperature reactors. Some interesting new developments explained at the conference relate to pressure vessels such as pressure vessels made of prestressed concrete with an external wire rope network or steel fiber lining, or made of prestressed hollow cast iron slabs. (GE)

25812 MAIN PROBLEMS OF FUTURE ENERGY SUPPLY. Wiss., Wirt., Polit.; 3: No. 41, 3-9(Oct 1973). (In German).

The papers presented at the Deutsche Ingenieurtag 1973 (conference of German engineers), organized by the VDI, and the subsequent discussions are summarized as far as they dealt with the future energy generation by nuclear power plants. The main reactor lines discussed are the fast breeder, the gas-cooled fast breeder, the high-temperature reactor and the fusion reactor. (GE)

25813 KERNREAKTOREN. (Nuclear Reactors. 5. Revised and Enlarged ed.). Kliefoth, W.; Sauter, E. Schriftenreihe des Deutschen Atomforums. Bonn, F. R. Germany; Deutsches Atomforum e.V. (1973). 147p.

49 figs.; 15 tabs.

This revised new edition of issue No. 2 of the series published by the Deutsches Atomforum is intended for the general reader and provides an introduction into the basic principles of nuclear energy generation. It further informs about research centers and other establishments that contributed to the progress made in the FRG in the field of nuclear science and technology and presents a comprehensive survey of the latest achievements in the development and construction of nuclear power plants. Due emphasis is placed on the safety of nuclear power plants and such interesting topics as the latest state of the development of high temperature reactors and fast breeders are dealt with in detail. (GE)

25814 NUCLEAR ENGINEERING IN THE UdSSR. First Restriction to Two Reactor Types – Then Priority to the Breeder Reactor. Morosow, I. G. VDI (Ver. Deut. Ing.) Nachr.; 28: No. 13, 14-15(Mar 1974). (In German).

3 figs.

In spite of its vast resources of fossil fuels, the USSR strongly favors nuclear power plants for meeting its future energy demands. During the first period, new power plants will be equipped with either of two reactor types, namely the PWR type reactor and the graphite moderated, steam/water-cooled reactor. In the long run, however, priority will be given to fast breeder reactors. The development of nuclear energy generation in the USSR and possible ways of co-operating with institutions and industrial establishments in the FRG, especially in the field of uranium enrichment, are discussed. (GE)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 25939, 25944, 25945, 25952, 25956, 25958–25962, 25970, 25977, 25994, 26044, and 26078.

25815 (DLCS-5000174) QUARTERLY OPERATING REPORT. First Quarter 1974. (Duquesne Light Co., Shippingport, Pa. (USA)). 1974. Contract AT(11-1)-292. 20p. Dep. NTIS $4.00.

During the first quarter of 1974, the Shippingport Atomic Power Station was operated as required for Duquesne Light Company system load demand, testing, and maintenance until February 4 when the station was shutdown. The 1A reactor coolant loop remained isolated during the first quarter. The primary coolant leak rate averaged 8 gph during the operational period of the first quarter. The Station was shutdown at 1700 hours on January 28 for repair of the river water booster pump strainer. The station was returned to power operation at 1300 on January 29. While performing the monthly overspeed trip checks on the turbine, the throttle valves inadvertently tripped closed. The generator was off the line between 0605 and 0622 on February 3 as a result of the throttle valve trip. The station was shutdown at 0006 hours on February 4 due to severe turbine-generator vibration. Failure of the rotating blading in the turbine caused the turbine-generator to become unbalanced resulting in extensive damage to the rotating and stationary blades and bearing. In addition, the vibration caused the generator hydrogen seals to leak which resulted in an explosion and fire. No station personnel were injured. The nuclear plant portion of the station was not involved and accordingly there was no release of radioactivity. The station was cooled down and remained in this condition for the remaining portion of the quarter. The BD core removal cooling system was placed in service to the 1B loop on February 7. During the period of the first quarter of 1974, two off-site shipments for burial of solid radioactive waste were made. The total shipment weighed 53,800 pounds and contained 66 millicuries of activity. (auth)

25816 (NEDO-20340) PROCESS COMPUTER PERFORMANCE EVALUATION ACCURACY. Carew, J. F. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Jun 1974. 64p. (74NED32).

Based on a detailed analysis of the on-line instrumentation and calculational systems the accuracy of the process computer core performance evaluation has been determined. The feedwater flow and temperature, core flow and pressure, LPRM and TIP flux measurement systems are considered and their uncertainties evaluated. The process computer calculational scheme is presented and, based on comparisons with gamma scan power distribution experiments and detailed nuclear calculations, the nuclear modeling uncertainties are determined. Estimates of the thermal-hydraulic modeling uncertainties are also presented. The synthesis and propagation of these uncertainties into the process computer evaluation are performed using a Monte Carlo error simulation. The results are presented as percent standard deviations of the evaluated local power and thermal limits. Process computer backup and software qualification procedures are also discussed. 19 references. (auth)

25817 (TID-26620) CORROSION SURVEILLANCE PROGRAM FOR LACBWR FORCED CIRCULATION SYSTEM PIPING. Topical Report No. 16. (Southwest Research Inst., San Antonio, Tex. (USA)). 7 Mar 1974. Contract AT(11-1)-1228. 114p. Dep. NTIS $8.75.

Paragraph 5.2.16 of the LACBWR Technical Specifications requires replacement of chromium-molybdenum piping in the forced circulation system if the reduction in pipe wall thickness is greater than 0.190 inch. Ultrasonic measurement of pipe wall thickness, which has been performed at four selected locations since March 1968, has shown that corrosion of this magnitude has not occurred at these locations. (auth)

25818 (WASH-1331) TECHNICAL REPORT ON DENSIFICATION OF GENERAL ELECTRIC REACTOR FUELS. (USAEC Regulatory Staff, Washington, D. C.). 23 Aug 1973. 73p. Dep NTIS $6.75.

An evaluation of the GE fuel-densification model is presented. The discussion of the GE model is arranged in the order of the four possible effects of fuel densification; increases in linear heat generation rate, local power spikes, creepdown and creep collapse, and changes in gap conductance and corresponding increases in fuel pellet stored energy. (DG)

25819 GAS TURBINES FOR EMERGENCY POWER GENERATION IN NUCLEAR POWER PLANTS. Bjoerk, G.; Martensson, K.; Daag, B. (Oskarshamnsverkets Kraftgrupp AB, Stockholm (Sweden)). Energie; 26: No. 4, 134-140(Apr 1974). (In German).

10 figs.

Calculations have shown that it would be economical to generate part of the power plant output by gas turbines. Normally, these GT units are operating for only a few hundred hours a year. In most cases, the peak load units have to be installed near those

plants which represent the greatest load on system and grid. This leads to a reduction of the load on the transmission system and enables the energy to be distributed even in the case of a disturbance in the main system. (GE)

25820 THREE-STAGE-TRANSFORMERS FOR LARGE POWER PLANTS. Pritsch, H. (Transformatoren Union A. G., Nuernberg (F. R. Germany)). Elektrotech. Z., B; 26: No. 8-9, 213-214(Apr 1974). (In German).

2 figs.; 1 tab.

The 1020-MVA-three-phase transformer delivered to the Philippsburg nuclear power station is described. (auth)

25821 BOILING CURVE MEASUREMENTS FROM A CONTROLLED FORCED CONVECTION PROCESS. Peterson, W. C.; Aboul Fetouh, M. M. (North Carolina State Univ., Raleigh). pp Paper No. 18 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22-23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

Work done previously to obtain data for construction of a complete boiling curve for pool boiling has been extended by the introduction of forced convection. A feedback system was employed to control the boiling process with forced convection, and new data has been obtained from which complete boiling curves for all boiling regions were obtained for two different values of turbulent flow rate. The boiling curve data is based on measurements of steady state heater voltage and current obtained by use of an improved technique involving use of digital instruments. The ambient liquid in these tests was distilled water maintained at saturation temperature under atmospheric pressure. (auth)

25822 REACTOR DESIGN: THE GENERATION OF RADIOACTIVITY. Philbin, T. W. (Environmental Analysts, Inc., Garden City, NY). pp 5-26 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (Ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

Information is presented concerning the basic design characteristics of PWR, BWR, and HTGR type power reactors. Radionuclides present in the primary coolant circuits of the three types of power reactors are reviewed. (DCC)

25823 CONTROL OF RADIOACTIVE WASTES IN OPERATING NUCLEAR FACILITIES. Cottrell, W. B. (Oak Ridge National Lab., TN). pp 72-131 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (Ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

Systems designed to remove gaseous, liquid, and solid radioactive wastes from PWR and BWR type reactors and nuclear fuel processing plants are described. Treatment and storage facilities for the radioactive wastes are reviewed. (DCC)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 25822, 25823, 25929-25931, 25933-25937, 25956, 25958-25964, 25969, 25977, 25979, 25980, 25994, 26072-26075, 26077, 26079, and 26089.

25824 (WCAP-3385-57) EVALUATION OF SAXTON CORE III FUEL MATERIALS PERFORMANCE. Smalley, W. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jul 1974. Contract AT(11-1)-3044. 177p. Dep. NTIS $7.60.

Approximately 250 mixed oxide (PuO_2-UO_2) fuel rods from Saxton Core II were reconstituted into seven new loose lattice assemblies and irradiated in Core III to peak burnups of up to 51,000 MWD/MTM. A sampling of these rods, representing a wide range of peak power levels and burnups, were subjected to hot cell examinations, including visual inspection, gamma scanning, profilometry, length measurement, collection and analysis of released fission product gases, metallography, burnup analysis, clad hydrogen analysis and mechanical testing of cladding specimens. One rod was removed at an interim shutdown in 1970 after 1720 EFPH in Core III; seven rods were removed at the mid-life shutdown (3720 EFPH); and eight rods were removed at end-of-life (5940 EFPH). These examinations showed that the overall performance of the PuO_2-UO_2 fuel was satisfactory. The fuel rods exhibited progressive changes in dimensions, fission gas release, oxidation of the cladding, fuel microstructure, and mechanical properties which were consistent with increasing burnup and higher power operation in Core III. Generally, these changes had no apparent adverse effects on the performance of the mixed oxide fuel. Defects which developed in certain high power rods between Core III mid-life and end-of-life did not appear to be related to any burnup, power or other inherent performance limit of mixed oxide fuel. 10 references. (auth)

25825 (WCAP-8183(Rev.1)) OPERATIONAL EXPERIENCE WITH WESTINGHOUSE CORES (UP TO APRIL 1974). Plocido, V. J.; Schreiber, R. E.; Skaritka, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jul 1974. 28p.

The cumulative operating experience of Westinghouse Zircaloy-clad fuel rods and other associated core components is summarized. Burnup experience, generic fuel abnormalities, rod bowing, cladding defects, rod cluster control assemblies, burnable poison assemblies, and other core components are discussed. (JWR)

25826 (WCAP-8234) SEISMIC TESTING AND FUNCTIONAL VERIFICATION OF BY-PASS LOOP REACTOR COOLANT RTD's. Lamb, V. F.; Capezzuto, F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jun 1974. 72p.

In a nuclear power plant, protection system equipment which initiates reactor trips, must be capable of performing its functions before, during and after an earthquake which is postulated to occur at a plant site. To demonstrate the ability of this equipment to perform under earthquake conditions and to perform under process conditions, Resistance Temperature Detectors (RTD's) as provided by two suppliers were subjected to vibration tests. The RTD's were subjected to vibration tests to provide design information in regards to performance under conditions which far exceeded any application presently used for the RTD's and which far exceeded any earthquake design basis for high seismic plants [in general, such plants will have a DBE (Design Basis Earthquake) ground acceleration in the range of 0.2 g to 0.4 g] presently in effect. The Sostman RTD was tested up to 200 g's at resonant frequency and the Rosemount RTD was tested up to 505 g's at resonant frequency. During the tests, the RTD's operation were monitored to prove proper performance of functions. The results show that there were no electrical malfunctions with the exception of the Rosemount RTD tested to failure. This failure occurred approximately 4-½ minutes into a 5 minute test where RTD tip accelerations of 505 g's were measured continuously at the RTD's resonant frequency. In addition to the seismic and functional verification tests, resonant frequency searches were performed on four RTD's, two from each supplier, to determine the resonant frequencies of the RTD's. The RTD resonant frequencies determined were in the 700 Hz to 1100 Hz range, which is on the order of 20 times higher than the 1-40 Hz seismic range. (auth)

25827 (WCAP-8253) SOURCE TERM DATA FOR WESTINGHOUSE PRESSURIZED WATER REACTORS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). May 1974. 207p.

A compilation of Westinghouse PWR operating data through June 1973 which is applicable to the evaluation of PWR radwaste treatment systems and the calculation of radioactive effluent source terms is presented. Concentrations of fission and corrosion products in the reactor cooling systems, iodine separation factors, primary to secondary leak rates, and tritium release data are also presented. An I-131 concentration model has been developed which is offered as a replacement for the "inferred" fuel defect concept. (DG)

25828 (WCAP-8381) REVISED CLAD FLATTENING MODEL. George, R. A.; Lee, Y. C.; Eng, G. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Fuel Div.). Jul 1974. 54p.

A revised clad flattening model is presented which, for a given fuel region, predicts the initial flattening time and the flattened rod frequency as a function of time. This model removes unnecessary conservatism particularly for pressurized fuel rods. 6 references. (auth)

25829 MODEL TEST ON RIVER WATER CONTINUOUS FLOW COOLING FOR A NUCLEAR POWER PLANT. P. 2. Mosonyi, E. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Wasserbau und Wasserwirtschaft mit Theodor-Rehbock-Flussbaulaboratorium). Energie; 26: No. 2, 51-59(Feb 1974). (In German).

18 figs.; 11 refs.

The tests relate to the cooling water building of the planned Gemeinschaftskernkraftwerk Neckar (GKN). The basic conditions governing these model tests, the model design, the measuring methods and the experimental programme are described. (GE)

25830 A NUCLEAR POWER PLANT IN THE ATLANTIC OCEAN. Arch. Energiewirtsch.; 28: No. 9, 437-449(May 1974). (In German).

5 figs.; 1 tab. Also published in Nucl. Eng. Int., 1973 v. 18(205).

The Atlantic Generating Station of Public Service Electric and Gas Company will be a 2,300 MW(e) nuclear power plant located approximately three miles off the New Jersey coast. The first unit is scheduled for commercial operation in 1980 and the second in 1981. Apart from the description of the overall generating

station and the discussion of some basic requirements, the special site-related design features and safety aspects are described. (GE)

25831 NON-AVAILABILITY INVESTIGATIONS OF EMERGENCY COOLING SYSTEMS. Assessment of Repair and Inspection Strategies. Boehm, B. (Kraftwerk Union A. G., Erlangen (F. R. Germany)); Blombach, J.; Rosenhauer, W. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). Atomwirt., Atomtech.; 19: No. 7, 368-372(Jul 1974). (In German).

6 figs.; 5 refs.

The safety of the emergency cooling systems depends especially on its mode of operation, as for example on how inspections and repairs are carried out. The already obtained high safety of these systems and the influence of systems variations are hardly proved by qualitative methods or criteria on deterministical basis. The influence of the different modes of operation is not determined, so that these cannot be optimized. These problems are only solved by the aid of quantitative systems analyses using probability considerations. For appropriate reliability characteristics to assess ECCS modern KWU-PWRs were chosen. The reliability criterion for assessing the safety of ECCS is the maximum value of non-availability. (GE)

25832 BOILER SIMULATION, PWR STATION DYNAMICS. Murrell, M. D. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). pp Paper No. 4 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

A system of differential equations was developed to describe the dynamics of PWR stations with either recirculating U-tube or once-through steam generators. The equations were programmed on the SATURN analogue computer and the simulation was used to investigate the ability of the station to respond to changes in load on the electrical system. The simulation and the results obtained are described. (auth)

25833 DYNAMIC BEHAVIOUR OF A 660 MW NUCLEAR POWER STATION. Frei, G.; Weber, J.; Hirmer, F. (Siemens A. G., Erlangen, Ger.). pp Paper No. 5 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

During the commissioning of the 660 MW(e) nuclear power plant at Stade in early 1972, numerous dynamic tests were made over the entire power range. The most important test results are explained with the aid of diagrams and compared with digital computer calculations. A brief description of the main plant systems and of the computer model is given. Some results of measurements with the special instrumentation of one of the four U-tube steam generators which led to some improvements of the analytical steam generator model are shown. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 24488, 24746, 25822, 25943, 26002, 26036–26038, 26043, and 26088.

25834 (GA-A-12909) STEADY-STATE PERFORMANCE OF A DIRECT-CYCLE NUCLEAR GAS TURBINE POWER PLANT. Covert, R. E.; Krase, J. M.; Morse, D. C. (General Atomic Co., San Diego, Calif. (USA)). 1 Mar 1974. Contract AT(04-3)-167. 27p. (CONF-740918-1). Dep. NTIS $4.50.

From joint power generation conference; Miami Beach, Florida, USA (15 Sep 1974).

The performance and principal operating characteristics of the Gas Turbine HTGR power plant are reported. The reference design of the dry cooled 1100-MW(e) power plant incorporates four helium gas turbine power conversion loops integrated into the prestressed concrete reactor vessel, which also contains the reactor and the entire primary coolant system. The reactor core is virtually the same as that for the comparable HTGR steam cycle and is operated with similar maximum fuel temperatures, resulting in a turbine inlet temperature of 1500°F (816°C). An overall plant efficiency of about 37% is realized with a design point cycle pressure ratio of 2.35 and with a high-effectiveness recuperator in each loop. Component performance and cycle performance calculations are discussed. The variation of plant performance with ambient temperature is described. Three distinct control modes are described which are, in order of decreasing part-load efficiency, helium inventory control, reactor outlet temperature control, and bypass flow (compressor outlet to turbine outlet) control. The latter offers the most rapid control of plant output. Also described is the standard operating control mode which combines reactor outlet temperature and bypass controls to facilitate both ramp and step load changes. 7 references. (auth)

25835 (GA-A-12916) HTGR BASE PROGRAM. Quarterly Progress Report for the Period Ending February 28, 1974. (General Atomic Co., San Diego, Calif. (USA)). 29 Mar 1974. Contract AT(04-3)-167. 259p. Dep. NTIS $7.60.

The High-Temperature Gas-Cooled Reactor (HTGR) work reported includes studies of basic fission-product distribution mechanisms, recycle fuel studies (including designing and testing of recycle test elements) and exploration of head-end reprocessing methods (as part of a national recycle plan and of a recycle fuel plan), and physics and fuel management studies. Materials studies include irradiation and analysis of fuel particles in capsules to evaluate fuel systems, and basic studies of control materials and of carbon and graphite. Experimental procedures and results are discussed and, where appropriate, the data are presented. (auth)

25836 (GA-A-12948) DESIGN AND CONSTRUCTION OF THE FUEL HANDLING MACHINE AT FORT ST. VRAIN. Ketchen, D. W. (General Atomic Co., San Diego, Calif. (USA)). 1 Apr 1974. Contract AT(04-3)-633. 21p. (CONF-740918-2). Dep. NTIS $4.25.

From joint power generation conference; Miami Beach, Florida, USA (15 Sep 1974).

The Fort St. Vrain Nuclear Power Generating Station employs some specialized pieces of equipment to perform the annual refueling operations. Among these are the fuel handling machine, used to move the fuel to and from the reactor core; the auxiliary cask, used to prepare penetrations for refueling by the removal of control rod drives; and the reactor isolation valve, used to isolate the reactor from the outside environment during refueling operations. The fuel handling machine is a self-shielded, gas-tight structure containing remotely and automatically operated mechanisms. The motions of these mechanisms, controlled by a small, on-line digital computer, are closed-loop servo in nature. The design of the fuel handling machine includes protection against the hostile environment in which it operates: (1) hot helium and (2) the radiation in the nuclear core. Both standard and unusual techniques were employed in its construction. Although the main structure of the machine was ordinary vessel design, relatively long centrifugal castings and intricately machined components were used. (auth)

25837 (GA-A-12951) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(e) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending March 28, 1974. (General Atomic Co., San Diego, Calif. (USA)). 30 Apr 1974. Contract AT(04-3)-633. 26p. Dep. NTIS $4.00.

The work reported for the Public Service Company of Colorado 330-MW(e) High-temperature Gas-cooled Reactor includes studies of component development, such as auxiliary equipment and special tools, and nuclear analysis of the fuel cycle, fuel zoning, and power shaping. The fuel development and fuel element proof testing portions of the report include demonstration testing of the performance of test fuel elements by means of irradiation at expected operating temperatures and capsule irradiation tests of production fuel. Studies covering the components of the steam generator under operating conditions are included. Experimental procedures and results are discussed and, where appropriate, the data are presented. (auth)

25838 (GULF-GA-A-12499-A) AFTERHEAT CALCULATIONS FOR THE HTGR. Sund, R. E. (General Atomic Co., San Diego, Calif. (USA)). Jul 1974. 68p. (GA-LTR-4(Amend. A)).

Afterheat rates were calculated for the HTGR utilizing new input information. The new afterheat results are a few percent higher than the HTGR afterheat results previously obtained in the 100- to 10,000-sec time range and are 11 to 15% higher than the previous results in the one-day to ten-days time range. The uncertainties were studied in the time region from 100 sec to ten days. The new results were also compared with calculations at other laboratories. The gamma-ray spectra were computed at several shutdown times for future applications in shielding studies. (17 references) (auth)

25839 (GULF-GA-A-12808(Vol. 3)) LARGE HTGR STEAM GENERATOR DESIGN VERIFICATION AND SUPPORT PROGRAMS: MATERIALS. Mazandarany, F. N.; Roberts, D. I. (General Atomic Co., San Diego, Calif. (USA)). 15 Dec 1973. 53p.

Materials-related test data and operating experience used in designing steam generators for large HTGR plants are summarized. Detailed test data on INCOLOY 800 and AISI 347 stainless steel are reviewed. (JWR)

25840 (JAERI-M-5513) MULSHES: A COMPUTER PROGRAM FOR PREDICTING THE TEMPERATURE AND STRESS CHANGES OF MULTI-SHELL TYPE FUEL ELEMENTS UNDER HIGH-TEMPERATURE REACTOR IRRADIATION. Arai, T.; Sato, S. (Japan Atomic Energy Research Inst., Tokyo). Jan 1974. 71p. (In Japanese). INIS.

The MULSHES Code predicts the changes of temperature and stress in multi-shell type fuel elements, such as cylindrical fuel pins and spherical fuel, under irradiation in a high-temperature gas cooled reactor. The calculational model and use of the code are described. The code, which takes space- and time-dependent irradiation conditions into consideration, can analyze the anisotropies of the graphitic materials and their irradiation effects. Features of the code are as follows: (1) Nonuniform distributions of the heat generation and fast neutron dose in the coolant-flow direction are considered. (2) Variation with time of the heat generation, fast neutron dose and coolant flow are considered. (3) Anisotropic characteristics of the elastic deformation and thermal expansion of graphitic materials are treated. (4) Irradiation effects of graphitic materials are treated, including thermal and mechanical property changes, irradiation-induced dimensional changes and creep deformation. (5) Temperature and stress distributions in the fuels are obtained for the boundary conditions between shells, regardless of the existence of mechanical interaction. The code is written in FORTRAN-IV for computer FACOM 230/60, and the core memory necessary is about 85 kilowords. (auth)

25841 (JUL-1054-MA) XENON OSCILLATIONS AND THEIR CONTROL IN LARGE POWER REACTORS. Hanke, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Angewandte Mathematik). Mar 1974. 43p. (In German). INIS.

44 figs.; 62 refs.

A mathematical model is described for the control of Xenon-transients in large HTGR type reactors. With the energy dependent diffusion approximation of neutron transport theory the optimum control is given from the solution of a coupled system of partial nonlinear differential equations. (GE)

25842 (JUL-1067-BB) NONDESTRUCTIVE DETERMINATION OF THE DISTRIBUTION OF U-235 AND Th-232 IN FUEL RODS WITHIN THE FRAMEWORK OF CHARACTERIZATION OF THE MONOLITHIC PRESSED HTR BLOCK FUEL ELEMENT. Lang, H.; Meixner, C. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Brennelement- und Bestrahlungstechnologie). May 1974. 51p. (In German). INIS.

28 figs.; 4 refs. With abstract.

In the framework of developing pressed block fuel elements for high-temperature reactors, it is necessary to non-destructively control the heavy metal distribution in the fuel zones in order to avoid local power differences and thus subsequent temperature increases during reactor operation. The aim is to obtain the most homogeneous distribution possible of uranium and thorium. Both elements are in the form of coated particles of varying diameter pressed into the fuel rods. A non-destructive determination of the uranium and thorium distribution in the fuel zones of the ready pressed blocks seems to be impossible. As it can be assumed that the change of the heavy metal distribution in the fuel zones during the final pressing of the block is so small as to be negligible, the testing of the ^{235}U and ^{232}Th distribution is carried out on the single rods not yet assembled in the block. This procedure allows the application of this characterization method not only to the monolithic fuel element, but also to the block-formed fuel element of the firm GAC. The testing system is suitable for later use in the production control. (GE)

25843 (SGAE-2268) NUCLEAR FUEL FOR GAS-COOLED HIGH-TEMPERATURE REACTORS. Proksch, E. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf, Inst. fuer Chemie). Apr 1974. 20p. (In German). Dep. NTIS (US Sales Only) $4.00.

The characteristics of the gas-cooled high temperature reactor are briefly indicated and the special characteristics required for its fuel are summarized. There are two principal types of coated particles envisaged for the HTR-rod and prismatic fuel elements and spherical fuel elements. Three possible fuel cycles are outlined. The principle and preparation of coated particles are discussed. The BISO and TRISO coatings are considered in detail. The consequences of a rupture of the coating as a result of high internal pressures are discussed and the subsequent fission product release is considered. Possible future developments in HTR fuel elements are described. 13 references. (JSR)

25844 850 DEGREES CENTIGRADE REACTOR HEAT FOR COAL GASIFICATION. Program Submitted for Introduction on the Market. Handelsblatt; 29: No. 31, 31(Feb 1974). (In German).

The Hochtemperatur-Reaktorbau GmbH (HRB), Cologne, has submitted a program concerning the introduction of nuclear process heat on the market. HRB is the manufacturer of the AVR reactor, Juelich, and is presently building the thorium high-temperature reactor (THTR) in Uentrop. (GE)

25845 ASSESSMENT OF THE THERMODYNAMIC EFFICIENCY OF THE CYCLE OF A NUCLEAR GAS TURBINE WITH WASTE HEAT RECOVERY FROM A WORKING MEDIUM CONSISTING OF GAS AND SOLID PARTICLES. Sapoznikov, V. V.; Elema, V. A.; Aizikovic, A. A.; Visnja, B. L. (Krasnodarskij Politekhnicheskij Inst. (USSR)). Arch. Energiewirt.; 28: No. 3, 127-133(Feb 1974). (In German).

4 figs.; 3 refs.

The thermodynamic aspects of the use of solid particles suspended in flows of gas as working medium in gas turbines of High Temperature Reactors are investigated. (GE)

25846 DYNAMIC RESPONSE OF THE HARTLEPOOL AGR STATION WHEN OPERATING IN A GRID FOLLOWING ROLE. Allen, D. G. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). pp Paper No. 2 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22-23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

An analogue simulation of the Hartlepool station is used to investigate the response of the station power control systems to disturbances in grid load. The main features of the simulation, which occupies five banks of the Saturn analogue computer and uses some 1250 amplifiers, are described. Results obtained from the investigation are discussed. (auth)

25847 DESIGN SENSITIVITY FOR AGR ONCE-THROUGH BOILERS. Hope, J. H. (Central Electricity Generating Board, London). pp Paper No. 9 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22-23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

As a result of tolerances in boiler components, errors in experimental correlations, and non-uniformities in boiler boundary conditions, it is possible for a particular boiler tube to exist in a significantly different state from the nominal design steady state. In order that control can be organized to keep the boiler within its design constraints, it is necessary to determine the magnitude of this difference. The effect of certain non-uniformities can be minimized by control point adjustment while the estimation of the effect of other non-uniformities requires knowledge of the degree of turbulence-induced mixing present within the boiler gas space. It is shown how a once through boiler steady state program can be modified to represent mixing and how the effect of tube blanking and non-uniformities in inlet gas temperature can be computed. (auth)

25848 MODELLING OF ONCE-THROUGH BOILER DYNAMICS. Taylor, E. (Nuclear Power Group Ltd., Risley, Eng.). pp Paper No. 10 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22-23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

Two models have been developed to analyze the transient behavior of once-through boilers, SIMBO and SIMBOL which use, respectively, moving mesh points and fixed nodes. The models have been programmed using the IBM digital simulation language C.S.M.P. and have been applied to AGR and HTR boilers. A comparison with some results from the CEGB program NUBOIL and OSCA is included. (auth)

25849 OPERATIONAL AND FAULT TRANSIENT STUDIES OF A ONCE-THROUGH AGR BOILER USING THE OSCA DIGITAL COMPUTER PROGRAM. Bickers, B. H.; Carstairs, R. L. (Atomic Power Construction Ltd., Sutton, Eng.). pp Paper No. 11 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

Digital computation of the transient behavior of a nuclear plant is considered, with emphasis on once-through boiler behavior. The OSCA (Overall Station Control Analysis) plant simulation program, which makes use of the CIP (Common Integration Program) systematic programming process, is described, and illustrative results are given of studies of AGR plant behavior in both normally controlled and fault conditions. (auth)

25850 STUDY OF OSCILLATORY INSTABILITIES IN THE PARALLEL CHANNELS OF A HIGH PRESSURE ONCE-THROUGH BOILER RIG. Fallows, T.; Hitchcock, J. A.; Jones, R. C.; Lis, J.; Northover, E. W. (Central Electricity Research Labs., Leatherhead, Eng.). pp Paper No. 14 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

An investigation is described in which the flow stability characteristics of a once-through boiler rig, simulating three parallel water/steam circuits of a typical AGR boiler, have been examined. The experiments covered a range of conditions relevant to start up, shut down and decay heat removal of AGR boilers, these being the operational conditions under which instabilities are most likely to occur. The majority of tests were concerned with determining the thresholds of oscillatory flow instabilities and some information on the frequency and amplitude of oscillations and the movements of "dry-out" boundary has been also obtained. The data have been compared with predictions of the theoretical model LOOP and it is shown that this model, in the forms considered in the paper, is not adequate for assessing flow stability in once-through boilers. To meet this limitation, an empiric correlation of the data is developed and the general validity of this correlation is discussed. (auth)

25851 FLOW STABILITY AND DYNAMIC BEHAVIOR OF NUCLEAR BOILERS. Beckmann, G. (Waagner-Biro A. G., Vienna); Fritz, K.; Lendl, H.; Gilli, P. V. pp Paper No. 15 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

Aperiodic (static) and periodic (dynamic) flow stability behavior of once-through nuclear boilers without intermediate headers, in particular for modern gas-cooled reactors, is investigated. By unifying treatment, considering aperiodic stability as the limiting case for zero frequency, the effects of gas mixing, gas/water-side coupling, and frequency on the various modes of instability are analysed. Using the TRANS code, frequency response curves of a HTR boiler are obtained without unallowable simplifications. (auth)

25852 COMPARISON OF THE BOILER MODEL NUBOIL WITH TRANSIENT MEASUREMENTS ON A ONCE-THROUGH BOILER RIG. Preston, R. W.; Lis, J.; Hitchcock, J. A. (Central Electricity Research Labs., Leatherhead, Eng.). pp Paper No. 17 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

The mathematical model NUBOIL has been compared with the results of a carefully controlled series of transient experiments carried out on a once-through boiler rig simulating the cross-counter flow gas/water system of a nuclear heat exchanger. A wide range of perturbation amplitudes and periods was used to examine the linearity of the system and its response to a frequency spectrum. The analysis revealed some appreciable discrepancies between the original model predictions and the experimental data, and it was necessary to introduce a number of modifications to improve the response predictions of the model. These modifications and the predictions of the modified model are described and discussed in detail. (auth)

25853 COMMISSIONING EXPERIENCE WITH THE CONTROL SYSTEMS FOR THE FRENCH NUCLEAR POWER STATIONS EDF-4 AND EL-4, AND CORRELATIONS WITH RESULTS OF MATHEMATICAL SIMULATIONS. Etienne, M. pp Paper No. 20 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

After a brief description of the control system lay-out for the EDF-4 and EL-4 power station steam generators, some important problems, which became apparent during commissioning of these plants, and the methods applied to solve these problems in each case are discussed. It is shown that a linear control system is in most cases capable of yielding satisfactory plant behavior under all possible operating conditions. Measured transients and those calculated with mathematical models are compared. It can be stated that a proven model will optimize time requirements for control system commissioning. (auth)

25854 CURRENT RESEARCH STATUS OF COATED PARTICLE FUELS FOR HTGR. Iwamoto, K. (Japan Atomic Energy Research Inst., Tokai). Nenryo Kyokai-shi; 53: No. 564, 223-232(Apr 1974). (In Japanese).

Great interest has been aroused recently in the HTGR from the viewpoint of alleviation of environmental problems as well as effective use of nuclear energy in Japan. The coated particle fuel for the HTGR is described, and current research aimed at improvement in fuel performance and economy is reviewed. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

25855 OPTIMIZATION OF NATURAL URANIUM HEAVY WATER MODERATED REACTORS FOR DESALINATION. P.1. Light Water Cooled. Fouad, H. Y. (Atomic Energy Establishment, Cairo (Egypt)). Atomkernenergie; 23: No. 3, 208-211 (1974).

2 tabs.; 21 refs.

Large anticipated future water shortages in Egypt are expected to be partly satisfied by nuclear desalination, for which a long-term program has to be adopted. A prototype 50 MW(t) is studied as a first step along nuclear desalination path. The concept comprised natural uranium metallic fuel, heavy water moderator, light water coolant and aluminium cladding as a first approach. Its design included an optimization study so as to match physical size requirements with that of thermal requirements to give an overall minimum size and hence best economics. Results are shown giving cell and core configurations. (auth)

25856 NUCLEAR RESEARCH AND DEVELOPMENT IN CANADA. Mooradian, A. J. (Atomic Energy of Canada Ltd., Chalk River, Ontario). Nucl. Eng. Int.; 19: No. 217, 489-492 (Jun 1974).

The nature of the Canadian research and development program in which 80% of the national effort is devoted to the single reactor concept CANDU is discussed. The facilities and the program designed to support the commercial CANDU-PHW reactor are described. The heavy water program is aimed at increasing existing plant production and improved flow sheets for future plants. Future coolant and fuel cycle options, which are discussed, include the CANDU-BLW and the organic-cooled CANDU-OCR variants. (UK)

25857 CANDU-PHW PROGRAM. Gray, J. L. (Atomic Energy of Canada Ltd., Montreal). Nucl. Eng. Int.; 19: No. 217, 476-477(Jun 1974).

The Canadian nuclear program, which is based on natural uranium fuelled heavy water pressure tube reactors is described and the advantages of this type of system are outlined from the point of view of economy, reliability, safety, and performance. (UK)

25858 ENGINEERING IN THE CANADIAN NUCLEAR POWER PROGRAM. Foster, J. S. (Atomic Energy of Canada Ltd., Peterborough, Ontario). Nucl. Eng. Int.; 19: No. 217, 478-480 (Jun 1974).

The activities of the companies (AECL, Ontario Hydro, and Canatom) engaged in engineering for nuclear generating stations in Canada are discussed. (UK)

25859 GENTILLY II. Cahill, L. (Hydro-Quebec); Monier, L. F.; Pon, G. A.; Renshaw, R. H.; Pelletier, J. B. Nucl. Eng. Int.; 19: No. 217, 481-485(Jun 1974).

The design of Gentilly-2, Quebec's first nuclear station, a 600MW(e) pressurised heavy water reactor, is described. Brief outlines are given of the coolant system, fuel, fuel-handling system, safety and shut-down systems, turbo-alternator unit, and station control systems. A colored wall-chart shows a cutaway drawing of the reactor and lists the main parameters. (UK)

25860 CANDU NUCLEAR POWER IN ONTARIO. Morison, W. G. (Ontario Hydro Research Lab., Toronto). Nucl. Eng. Int.; 19: No. 217, 486-488(Jun 1974).

The Ontario Hydro nuclear system for electricity generation, which is based on the Candu type heavy water moderated and cooled horizontal pressure tube reactors, is surveyed. Performance and economics of the four Pickering units are discussed. Progress on the construction of the Bruce station and plans for future installations and for heavy water production are summarized. (UK)

Power Reactors, Breeding

Refer also to abstracts 24532, 24540, 24552, 24736, 25238, 25932, 25940, 25942, 25946, 25948, 25954, 25957, 25982, 25995, 26018, and 26039–26042.

25861 (AI-AEC-13124) FUELS, MATERIALS, AND CONTROL ROD DEVELOPMENT PROGRAMS. Quarterly Technical Progress Report, January–March 1974. (Atomics International Div., Canoga Park, Calif. (USA)). 15 May 1974. Contract AT(04-3)-824. 29p. AT.

The studies include radiation effects on Type 316 stainless steel, helium generation in ^{10}B and other reactor materials, and control absorber heating experiments and calculations. (JWR)

25862 (AI-AEC-13133) FUEL TRANSFER MACHINE COMPONENT TEST. Annual Technical Progress Report, Government Fiscal Year 1974. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Aug 1974. Contract AT(04-3)-824. 72p. AT.

Progress in the development and testing of handling devices for core components for an LMFBR plant with under-the-shield refueling and reactor vessel cover rotating plugs is reported. The devices include an in-vessel transfer machine, an ex-vessel transfer machine, an auxiliary handling machine, floor valves, and core component service equipment. (JWR)

25863 (CENC-1194(Vol.3)(Suppl.1)) LMFBR DEMONSTRATION PLANT STEAM GENERATING SYSTEM. (Combustion Engineering, Inc., Chattanooga, Tenn. (USA)). Feb 1973. Contract AT(11-1)-3031. 133p. Dep. NTIS $9.75.

Specifications for the design, material selection, fabrication, testing, inspection and installation of the sodium heated steam generator water/steam circulation system (SGWCS) for the 1000 MWt LMFBR Demonstration Plant are presented. (auth)

25864 (CENC-1197(Vol.2)) LMFBR SODIUM HEATED STEAM GENERATOR: TEST MODEL. (Combustion Engineering, Inc., Chattanooga, Tenn. (USA)). Feb 1973. Contract AT(11-1)-3031. 229p. Dep. NTIS $14.50.

The integrated manufacturing quality plan for the 30 MW(t) sodium test model evaporator and superheater of a LMFBR steam generator is presented. (DCC)

25865 (CONF-721018-(Vol. 5), pp 1404-1426) INVESTIGATION OF THE DISTRIBUTION OF INTERMEDIATE NEUTRONS AND CAPTURE GAMMA RADIATION IN FAST REACTOR SHIELDING. Bolyatko, V. V.; Kulakovskii, M. Ya.; Mashkovich, V. P.; Sinitsyn, B. I.; Suvorov, A. P.; Troshin, V. S.; Khokhlov, V. F.; Tsypin, S. G. (Inst. of Physics and Power Engineering, Obninsk, USSR). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

A series of experimental investigations of the space-energy distributions of intermediate neutrons and secondary capture gamma radiation in a wide variety of shielding media (including shielding with inhomogeneities) has been conducted with a specially constructed "intermediate neutron converter" using the B-2 beam of the BR-5 fast reactor. The experimental results are compared with the results of calculations performed in the $2D_3P_5$ approximation of the discrete-ordinate method for homogeneous media and by parametric methods for media with inhomogeneities. (17 references) (auth)

25866 (CONF-740903-2) NEUTRON STREAMING IN PLATE CRITICALS. Wade, D. C.; Gelbard, E. M. (Argonne National Lab., Ill. (USA)). 1974. 15p. Dep. NTIS $4.00.

From meeting on advanced reactors; physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

Questions concerning neutron streaming in the sodium-void columns of LMFBR and helium-coolant columns of GCFR plate criticals are examined. The homogeneous isotropic diffusion coefficient is shown to substantially underpredict leakage in the axial direction. A misprediction of leakage is shown to produce only slight errors in neutron spectrum and such integral parameters as fission ratio. However, eigenvalue and material worths are found to be quite sensitive to leakage. One-dimensional unit cell modeling prescriptions are described which yield accurate cell-average, microscopic isotopic cross sections and Benoist diffusion coefficients in the presence of streaming. (auth)

25867 (CONF-740910-1) TOPPING AND BOTTOMING CYCLES. Fraas, A. P.; Brooks, R. D. (Oak Ridge National Lab., Tenn. (USA); General Electric Co., Cincinnati, Ohio (USA)). 1974. Dep. NTIS $4.50.

From 9th world energy conference; Detroit, Michigan, USA (22 Sep 1974).

A review of the more interesting special thermodynamic cycles and working fluids that have been investigated in recent years is presented. These cycles are compared briefly, and then the development problems and status of the two leading contenders, the gas turbine and potassium vapor topping cycles, are examined in more detail. (auth)

25868 (GA-A-12894) GAS-COOLED FAST BREEDER REACTOR. Quarterly Progress Report, November 1, 1973–January 31, 1974. (General Atomic Co., San Diego, Calif. (USA)). 12 Apr 1974. Contract AT(04-3)-167. 72p. Dep. NTIS $5.45.

The tasks of the Gas-Cooled Fast Breeder (GCFR) program are program planning, core development, out-of-pile heat-transfer and fluid-flow tests, development of a pressure-equalization system for fuel rods, fuels and materials development, and nuclear analysis and reactor physics. The core development task is to establish criteria for the design of the GCFR fuel, control, and blanket element assemblies. Analytical methods are being developed for predicting fuel-rod response to transient conditions and for treating thermal-hydraulic and structural analyses of fuel assemblies. For the heat-transfer and fluid-flow tests of fuel assemblies, planning of the test program and sizing of the proposed test facility were continued. The development work on the pressure-equalization system included designing the test assemblies for static adhesion tests and seal leakage tests of mating parts, development of the fuel-rod manifold, and development of an analytical model for designing monitoring instrumentation. In the fuels and materials task, the status of the thermal- and fast-flux irradiation programs and analyses of data from these experiments is given. Nuclear analysis and reactor physics work included planning and analytical work for a GCFR critical experiment, surveillance of LMFBR critical assembly experiments, and methods development. (auth)

25869 (GA-A-13021) GAS-COOLED FAST BREEDER REACTOR. Quarterly Progress Report, February 1–April 30, 1974. (General Atomic Co., San Diego, Calif. (USA)). 14 Jun 1974. Contract AT(04-3)-167. 81p. Dep. NTIS $5.45.

The tasks of the Gas-Cooled Fast Breeder (GCFR) program are program planning, component development, reactor system safety, core development, out-of-pile heat-transfer and fluid-flow tests, development of a pressure-equalization system for fuel rods, thermal shielding, fuels and materials development, and nuclear analysis and reactor physics. The core development task is to establish criteria for the design of the GCFR fuel, control, and blanket element assemblies. Analytical methods are being developed for predicting fuel-rod response to transient conditions and for treating thermal-hydraulic and structural analyses of fuel assemblies. Planning of the test program and test facility for the heat-transfer and fluid-flow tests of fuel assemblies continued. The development work on the pressure-equalization system included obtaining the test assemblies for static adhesion tests and seal leakage tests of mating parts, development of an analytical model for designing monitoring instrumentation, and development of the fuel-rod manifold. In the fuels and materials task, the status of the thermal- and fast-flux irradiation programs and analyses of data from these experiments is given. Plans are being formulated for an in-pile loop test program. Nuclear analysis and reactor physics work included planning and analytical work for a GCFR critical experiment, surveillance of LMFBR critical assembly experiments, and analytical methods development. (auth)

25870 (GEAP-13825-9) INSTRUMENTATION DEVELOPMENT. Ninth Quarterly Report, January–March 1974. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Apr 1974. Contract AT(04-3)-893. 20p. AT.

The development of instrumentation for surveillance of the core and in-vessel components of liquid metal fast breeder re-

actors is reviewed. Current development efforts are focused on high temperature neutron detectors and reactivity monitoring systems. (7 references) (auth)

25871 (GEAP-13969) CLADDING LOADING SENSITIVITY STUDIES FOR LMFBR FUEL RODS. Sim, R. G.; Vaidyanathan, S. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Jan 1974. Contract AT(04-3)-893. 56p. AT.

A cladding loading sensitivity study was made on 20% cold-worked Type-316 fuel rod cladding operating in a typical Liquid Metal Fast Breeder Reactor (LMFBR) with a mixed mean coolant outlet temperature of 1000°F. In the sensitivity study, only loads due to normal operating conditions were considered. The response of the cladding at the top of the core and the core midplane axial locations in hot, peak power, average power, and minimum power fuel rods was analyzed in detail for a variety of loads. The loads analyzed include the effect of fission gas pressure, cladding wall thinning, prototypic cladding temperature effects, fuel-to-cladding mechanical interaction, and spacer contact loads. The conclusions of the analyses are given. The analyses were made by using one-, two-, and three-dimensional structural analysis procedures. The analysis techniques included finite element and other more direct methods. Some conclusions on the type of analysis tools required for fuel rod design are given. (9 references) (auth)

25872 (KFK-1904) INCREASE IN CENTRAL TEMPERATURE DUE TO REDISTRIBUTION OF URANIUM AND PLUTONIUM IN FAST REACTOR MIXED OXIDE FUELS. Bober, M.; Schumacher, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Apr 1974. 40p. (In German). Dep. NTIS (U. S. Sales Only) $5.00.

Results of post irradiation examinations of redistribution of uranium and plutonium in fast reactor mixed oxide fuel pins are reviewed. Redistribution by evaporation-condensation processes clearly depends on stoichiometry and only to a less degree on power rating and burnup. It mainly develops in the first stage of fuel restructuring. At the central void the plutonium enrichment yields up to 170% of the average concentration. This causes an increase in central temperature up to 150°C. The enrichment due to redistribution by thermal diffusion is mainly determined by power rating and burnup. It still grows until the irradiation has been finished. At a power rating of 500 W/cm the enrichment of plutonium yields up to 140% which increases the central temperature up to 100°C. (31 references) (auth)

25873 (KFK-1960) UO_2-PuO_2 FUEL PIN BUNDLE IRRADIATION DFR-350. Evaluation of the Post-Irradiation Examination Results. Ehrlich, K.; Goetzmann, O.; Kleykamp, H.; Schaefer, L.; Schulz, B.; Zimmermann, H.; Dienst, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Jun 1974. 103p. (In German). Dep. NTIS (US Sales Only) $8.25.

In the irradiation test DFR-350, UO_2-PuO_2 fuel pins (290 mm fuel length) were irradiated in a pin bundle cooled by flowing NaK. Irradiation was performed in the fast neutron flux of the test reactor DFR (Dounreay) at mean rod powers between about 320 W/cm (bottom fuel end) and 440 W/cm (neutron flux maximum) to a maximum burnup of 5.7 at. % (U + Pu). The maximum fast neutron fluence amounted to 3.8×10^{22} n/cm^2 (E > 0.1 MeV). The mean cladding i.d. temperature was between about 300°C and 650°C (at the cooler end and at the hot end of the fuel pin). The post-irradiation examination of 15 fuel pins is described. The amount of fission gas was measured in three steps as released fission gas, as gas retained in large bubbles, and as gas retained in small bubbles and crystal lattice sites. This was done by piercing the fuel pins, by grinding the fuel, and by dissolving the powdered fuel chemically. In evaluating the fuel microstructure observations radial porosity distribution was analyzed for two cross-sections each of 7 fuel pins. The porosity measurement needed was done by an electronic image analyzer. Electron microprobe analysis was applied to examine plutonium redistribution, fission-product behavior, and cladding corrosion. The changes of cladding mechanical properties under irradiation were measured by stress-rupture tube burst tests and by tensile tests on cladding sections. The swelling behavior of the cladding materials was studied by transmission electron microscopy, cladding diameter and immersion density measurements. The results of the various examinations are presented. (auth)

25874 (ORNL-TM-4658) FAST REACTOR EXPERIMENTAL SHIELDING PROGRESS REPORT FOR MARCH 1974. 189a No. 10028, Activity No. HN 94 01 01 1. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N. (Oak Ridge National Lab. Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 29p. AT.

The Total Cross-Section Check Program was continued. Background problems encountered in earlier measurements were resolved. Bonner ball and/or NE-213 measurements to verify the total cross sections for Fe, Ni, C, Na, SS and Cr were completed, and the results are presented. Hydrogen counter measurements were also taken; however, unfolding problems still exist with the hydrogen counter data and the results are not included. (auth)

25875 (RDT-E-6-40T(5-74)) PISTON RINGS OF HIGH STRENGTH ALLOYS FOR CORE COMPONENTS FOR LIQUID METAL SERVICE. (USAEC Division of Reactor Research and Development, Washington, D. C.). May 1974. 13p. RSO.

The requirements for the material, fabrication, quality assurance, packaging, and delivery of piston rings of high strength alloys for applications in liquid metal cooled reactor cores are presented. The rings may be in the as-fabricated condition or may be coated with a protective material to provide improved resistance to wear, galling, corrosion, or other environmental conditions. (auth)

25876 (RT/ING-(74)2) EXPERIMENTAL STUDY ON HEAT TRANSFER IN LONG SUB-CRITICAL ONCE-THROUGH STEAM GENERATORS. Campolunghi, F.; Cumo, M.; Ferrari, G.; Leo, R.; Vaccaro, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jan 1974. 29p. (CONF-731020-3). Dep. NTIS (US Sales Only) $4.50.

From international heat transfer meeting; Karlsruhe, F. R. Germany (9 Oct 1973).

In long once-through steam generators (like L.M.F.B.R. types) with very high L/D values and relatively low surface heat flux values, the usual well fit burn-out correlations deduced for reactor core reference situations low L/D ratio and high surface heat fluxes show sensible errors and may not be directly applied. Two separate pressure ranges do appear, delimited by $p/p_{cr} < 0.4$ and $p/p_{cr} > 0.5$, in which burn-out qualities are substantially different and two different burn-out mechanisms seem to exist. At pressures $120 < p < 160$ kg/cm^2 the Becker correlation fits experimental data quite well. (auth)

25877 (R/M/N-705) ULTRASONIC UNDER SODIUM VIEWING FOR FAST REACTORS: PRINCIPLES AND PROBLEMS. Glendenning, I.; Hepworth, J. K.; Little, M. J.; Varey, R. H.; Wright, D. G. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.). Oct 1973. 14p. Dep. NTIS (US Sales Only) $4.00.

The principles and problems involved with ultrasonic systems for examining components under sodium are outlined. In view of experience in other fields it is concluded that such systems have considerable potential for development for fast reactors. (auth)

25878 (WARD-HT-3045-6) VALIDATION OF HIGH TEMPERATURE DESIGN METHODS AND CRITERIA. Quarterly Progress Report for Period Ending May 31, 1974. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Aug 1974. Contract AT(11-1)-3045. 140p. AT.

Research on the inelastic behavior and strain tolerances of Types 304 and 316 stainless steel base materials for LMFBR components is reported. Testing of plates, bars, tubular specimens, and more complex structures is described. The design of the Multiloading Test Facility is reviewed. Studies on creep racheting of the FFTF intermediate heat exchanger inlet nozzle are discussed. Improvements in the structural analysis codes used are summarized. (JWR)

25879 (WARD-RB-3045-5) RADIAL BLANKET DESIGN AND DEVELOPMENT. Quarterly Progress Report for Period Ending February 28, 1974. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jun 1974. Contract AT(11-1)-3045. 45p. AT.

Progress in the design and development of LMFBR radial blankets during the quarter is reported. The research included heat transfer testing, irradiation testing in EBR-2, and flow orificing testing. (JWR)

25880 PROBLEMS OF STRUCTURAL DEFORMATION AND THE CORE RESTRAINT SYSTEM IN SODIUM-COOLED FAST BREEDER REACTORS. Glass, G.; Hoang, Y. S. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). KFK Nachr.; 6: No. 1, 13-18(1974). (In German).

3 figs.

Because of the possible changes in the neutron multiplication factor as a result of power-dependent structural changes of the reactor core, it has been necessary to study these changes so that they could be taken into account in the design of the reactor core. Conceptual designs of a core restraint system as well as analytical methods for computing the behavior of the reactor core are presented. Furthermore, the core restraint system of the SNR-300 and its characteristics are described in detail. (GE)

25881 INVESTIGATION OF THE INFLUENCE OF THE HEAT TRANSFER COEFFICIENT IN THE GAP BETWEEN FUEL AND FUEL CAN WITH REGARD TO THE SAFETY DESIGN OF FUEL RODS FOR FAST BREEDER REACTORS. Godesar, R. Aachen, Ger.; Technische Hochschule (1972). 128p. (In German). INIS. 14 figs.; 14 tabs.; 43 refs.; with app. Available from the library of the Techn. Hochschule Aachen.

After a general discussion of the basic features of heat transfer processes in the gap between fuel and cladding, ten heat transfer models are described. This is followed by an account of experimental studies on the heat transfer coefficient in the gap. All parameters affecting the heat transfer in the gap are determined mathematically for various boundary conditions and are then examined with regard to their importance in the design of fuel rods for fast reactors. (GE)

25882 SODIUM-COOLED FAST BREEDER REACTORS; EUROPEAN COMPETITION FOR THE FUTURE. Ber. Inform. (Eur. Gemeinsch.); No. 1, 5-6(Jan 1974). (In German).

A brief review is given of the various fast breeder reactor projects. (GE)

25883 HYBRID SIMULATION OF THE STEAM GENERATING SYSTEM OF A LMFBR WITH CONTROL LOOPS. De Boer, G. A.; De Hes, M. (Neratoom N. V.; The Hague, Netherlands). pp Paper No. 6 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22-23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

The mathematical relations describing the dynamic behavior of the steam generating system of a LMFBR have been programmed for a hybrid computer. Details of the computer model and the heat-transfer relations are given as well as the calculation procedure. A suitable control scheme for the plant has been developed. The responses of the plant to load changes and a reactor scram are given. (auth)

25884 HEAT TRANSFER REGIMES AND TRANSITIONS IN BOILER DYNAMICS MODELS. Knowles, J. B.; Robins, A. J. (Atomic Energy Establishment, Winfrith, Eng.). pp Paper No. 12 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22-23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

Primary side, secondary side, and wall heat transfer coefficients may be of the same order of magnitude for a significant portion of the high subcritical pressure boiler associated with a liquid metal cooled nuclear reactor. Forms of heat transfer correlation most appropriate for high subcritical pressure conditions and the physical processes associated with the heat transfer mechanisms are discussed. Approximations to the recommended correlations are proposed which economize in computer time. Proposals are made for handling the problems that arise from transitions in the heat transfer mechanism or fluid phase in dynamic models, e.g. between nucleate boiling and post-dryout heat transfer. The necessity for including the thermal storage in the tube walls is also shown. (auth)

25885 HOT VAPOR CIRCUIT FOR HEAT TRANSFER CORROSION TESTS: PROJECT; OPERATION; PRELIMINARY RESULTS. von Erbacher, F. J.; Jennert, D.; Leistikow, S.; Vasarhelyi, J. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). pp 395-397 of Fifth European Congress of Corrosion. Paris; Federation Europeenne de la Corrosion ([nd]). (In German).

From 5th European congress of corrosion; Paris, France (24 Sep 1973).

The research project is presented. The operation of the hot-steam loop designed for heat-transfer studies in connection with steam-cooled fast breeder reactors is discussed. The corrosion properties of Cr-Ni steels and Ni alloys were investigated. Preliminary results are given: increasing the Ni contents reduces cold deformation corrosion; no increase in corrosion was observed with sheets tested for 1000 hours at high temperatures under dynamic conditions (600°C, 150 atmospheres). (FR)

25886 BREEDER REACTORS. Yevick, J. G. (Atomic Energy Commission, Washington, DC). pp 234-369 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (Ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

The development of breeder reactors is reviewed. Reactor physics and specifications for components and systems of LMFBR type reactors are presented. Safety aspects are described including reactor accidents, radioactive wastes, environmental aspects, and nuclear materials management. (DCC)

25887 SODIUM-COOLED FAST BREEDER REACTOR. The State of Development, Core Design, and Safety. Tokyo; Atomic Energy Society of Japan (1973). 106p. (In Japanese).

The results of surveys by an experts' committee on fast breeder reactors in the Atomic Energy Society of Japan from October 1970 to September 1972 are presented. Covered are the state of developments in various countries, core designs, and safety aspects including the energy release and the impact stress at the time of a hypothetical accident and the propagation of a localized fuel failure. The progress in research and development in this field is proceeding at a rapid rate. (JA)

Research, Test, and Experimental Reactors

Refer also to abstracts 25878, 25993, 26009, 26018, 26023, 26082, and 26121.

25888 (AAEC/LIB/Bib-419) ZERO-POWER REACTORS: SAFETY AND ACCIDENTS. A Bibliography. Woods, L. F. (comp.). (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1974. 53p. Dep. NTIS (US Sales Only) $5.75.

The literature search covers the period 1960-1974. Abstracts checked were: Indexed bibliography of current nuclear safety literature 1 to 23; ORNL-NSIC-8, 9, 12, 14, 16, 19, 20, 32, 34, 36, 40, 42, 44, 45, 52, 54, 58, 59, 62, 67, 70, 71, 72 (April 1965 to February 1970); INIS Atomindex (INIS) to vol. 5, no. 8, 1974; Nuclear Science Abstracts (NSA) to vol. 29, no. 8, 1974; and Safe operation of critical assemblies and research reactors, Safety series no. 4, IAEA, Vienna, STI/PUB-29, 1961. (auth)

25889 (ANCR-1166) DECONTAMINATION AND DECOMMISSIONING OF THE EBR-1 COMPLEX. Topical Report No. 1, Removal of NaK from EBR-1 Storage Pit. Commander, J. C. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jun 1974. Contract AT(10-1)-1375. 13p. Dep. NTIS $4.00.

Radioactively contaminated waste from the First Experimental Breeder Reactor (EBR-I) Mark II core meltdown has been stored at the EBR-I storage pit since 1955. The objective of this activity was to remove the waste material from the storage pit to another temporary storage area. Prior to performance of this work it was necessary to conduct a radiation survey, perform a radiation and chemical hazards evaluation, select alternative storage, develop an operating procedure, and fabricate special handling tools. The radiation survey indicated activity levels of 200 mR/hr at the top of the sodium-potassium eutectic alloy (NaK) storage pit, and levels at contact with the waste packages ranging from 500 mR/hr to 7 R/hr. The radiation hazards evaluation established the shielding requirements and the necessity for remote handling tools for removal of the waste packages from the pit. In addition, it was established that no criticality accidents could occur as a result of rearranging the waste packages. The chemical hazards evaluation provided assurance that the work of moving the waste packages could be accomplished without risk of explosion due to the reaction of the NaK with potassium superoxide (KO_2). A survey of excessed National Reactor Testing Station (NRTS) facilities was performed which resulted in the selection of the Army Re-Entry Vehicle Facility Site (ARVFS) bunker for temporary storage of the radioactively contaminated waste packages. NaK removal, transportation and restorage procedures were developed and approved by AEC-ID. The procedure and all required equipment and handling tools were checked out during a rehearsal conducted prior to the scheduled work of NaK removal from EBR-I. The radioactively contaminated packages of NaK were removed from the EBR-I storage pit on April 4, 1974 and transported across the NRTS to the ARVFS bunker where they were placed in temporary storage, secure from public access. All actions associated with this activity were conducted safely and with no incidents. (auth)

25890 (BNL-18974) HFBR TAILORED-BEAM FACILITY. Chrien, R. E.; Rimawi, K.; Wasson, O. A.; Greenwood, R. C. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 5p. (CONF-740920-1). Dep. NTIS $4.00.

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

A flexible filtered neutron beam facility has been installed at the High Flux Beam Reactor at Brookhaven. The characteristic parameters of the various beam filters-iron/aluminum, lithium, and bismuth are given. Examples of the application of these beams to experiments on neutron capture γ-rays are discussed. (auth)

25891 (EUR-4888) INTEGRATION OF A STIFF DIFFERENTIAL SYSTEM RELATED TO THE DYNAMICS OF A NUCLEAR

REACTOR. Benuzzi, A.; Guerri, L. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). 1972. 22p. (In Italian). INIS.

Integration by means of a semianalytic method of a stiff differential system related to the dynamics of the pulsed reactor SORA is described. (INIS)

25892 (FEI-433) CANAL-LOOP WITH NATURAL CIRCULATION OF THE COOLANT FOR IRRADIATION OF FUEL ELEMENTS. Bul'kanov, M. G.; Kurov, V. A.; Klochko, G. A.; Martynov, A. D.; Potolovskii, V. G.; Selivanov, V. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A loop installation for the irradiation and testing of fuel elements is described. The principles of the primary circuits of the installation, the construction of the channels for two types of fuel elements, and the heat exchangers placed within the channels to guarantee the natural circulation of the coolant are described. The basic data on the operating conditions for the installation in the first nuclear power plant and the basic parameters during operation of the loop at a power of 28 kW are reported. The advisability of using similar types of installations for studying fuel elements at heat fluxes of the order of 1.3×10^6 W/m^2 is shown. The work can be used during the development of devices for in-core irradiations and testings on different types of fuel elements and materials. (tr-auth)

25893 (GEAP-14001) EVALUATION AND ANALYSIS OF ZPPR ASSEMBLY 3 CRITICAL EXPERIMENTS. Stewart, S. L.; Hartman, A. K.; Crick, S. C. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Apr 1974. Contract AT(04-3)-893. 221p. AT.

A series of critical experiments have been performed in ZPPR Assembly 3 to investigate the effects of the control system on nuclear parameters of a Demonstration Plant as part of the Demonstration Plant Benchmark Critical Program. The intent of ZPPR-3 was to examine the influence of a specific control system design on the nuclear parameters of a typical LMFBR Demonstration reactor. The principal reactor parameters experimentally studied in ZPPR-3 were power distribution, control worth, and sodium void reactivity effects. ZPPR-3 was a 2400 liter two enrichment zone core with 19 simulated control rods. The experimental program is divided into 3 phases corresponding to end-of-cycle, middle-of-cycle, and beginning of-cycle control conditions. The analytical approach used was to use normal reactor design methods where possible and to calibrate these methods against experimental data. Most analysis was performed with two-dimensional (X, Y geometry) diffusion theory calculations in 6 energy groups. (auth)

25894 (HEDL-TME-72-106(Rev. 2)) FAST FLUX TEST FACILITY COUPON SURVEILLANCE PROGRAM. Moen, R. A. (ed.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-2170. 215p. AT.

The FFTF Coupon Surveillance Program is designed to prevent failures of critical components of the FFTF coolant circuits by monitoring the condition of premachined mechanical test specimens (coupons) of the actual materials of construction to determine the response of the component to the environmental service conditions. The guidelines, criteria, and requirements for the program are presented. (DG)

25895 (HEDL-TME-72-107(Rev.2)) FFTF MATERIALS ARCHIVE PROGRAM. Moen, R. A. (ed.). Hanford Engineering Development Lab., Richland, Wash. (USA)). 1 Apr 1974. Contract AT(45-1)-2170. 88p. AT.

This document will provide a single reference for the FFTF Materials Archive Program. It will serve as a vehicle for documenting what is placed in the Archive and what has been removed from the Archive. Case histories of component materials problems which have involved the withdrawal and testing of Archive material will be added as they become available. The material certification records on all materials in the Archive can be summarized in various ways by properly programming for retrieving the computer-stored data. These data can be included and could be very useful to the material technologist as well as to the designer of future reactor plants. (auth)

25896 (IEA-23) REACTOR IRRADIATIONS AND ACTIVATION CALCULATIONS. Filho, A. C. P. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Nov 1972. 56p. (In Portuguese). Dep. NTIS (US Sales Only) $6.00.

With the purpose of the practical utilization, methods of reactor induced activation calculations are presented. These calculation methods involve continuous and intermittent irradiations. The most frequent irradiations at the IEAR-1 reactor are specially considered. Besides the activation calculations several other aspects related with the irradiations themselves are considered. In order to facilitate the choice of the irradiation targets, some aspects that could influence the irradiations safety and efficiency are mentioned. Specially some phenomena that has influence at the irradiation facilities and the reactor safety are considered. The induced parasitic activities in the sample and capsules or vials are considered. Specially the effects of parallel activations, secondary activations, second order activations and the formation of elements genetically related, are considered. Also some factors such as the neutron flux variations and total flux perturbation are mentioned. The importance of the burnup of high cross section isotopes during irradiation are put in evidence. Graphics and formularies to facilitate the activation calculations and the characteristics required for the target more suitable for the irradiations are presented. 37 references. (auth)

25897 (KFK-1865) EXPERIMENTS IN PURE URANIUM LATTICES WITH UNIT K(INFINITELY). Assemblies SNEAK-8/8Z; UK 1 and 5 in Ermine and Harmonie. Chaudat, J. P.; Darrouzet, M.; Fischer, E. A. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik; Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Schneller Brueter; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Div. d'Etude et de Developpement des Reacteurs; CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France). Div. d'Etudes et de Developpement des Reacteurs). 1974. 138p. (CEA-R-4552). INIS.

With figs.; tabs.; 19 refs. With abstract in English, German and French.

Physics measurements in pure uranium lattices with k(infinity) (production/absorption) close to unity were carried out in the critical facility SNEAK at KARLSRUHE (cores 8 and 8Z), the fast thermal coupled facility ERMINE at FONTENAY-AUX-ROSES (cores UK 1 and UK 5) and the exponential experiment HARMONIE at CADARACHE (core UK 5). All the experimental results were analyzed using the GfK and CEA methods, thus providing an extensive intercomparison of experimental techniques on one side, and of cross section data on the other side. The experimental results were then combined, and extrapolated to obtain best estimates for the parameters of a pure homogeneous uranium medium of exactly unit k(infinity). This medium is proposed as a standard for nuclear data testing. (auth)

25898 (KFK-Ext-23/74-1) RESULTS OF MONITORING FOR TRITIUM INCORPORATION AT THE KARLSRUHE NUCLEAR RESEARCH CENTER IN 1973. Wechselberger, E.; Schiefer-decker, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Medizinische Abt.). Apr 1974. 5p. (In German). INIS.

3 tabs.; 4 refs. With abstract in German and English.

In 1973, a number of 461 persons were monitored for tritium incorporation. It appeared that unduly high incorporations did not occur. The maximum radiation burden due to tritium incorporation ranged from 50 to 200 mrem/a for persons working at the FR-2 and MZFR and was lower than in the year before. (auth)

25899 (ORNL-TM-4628) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, JANUARY, FEBRUARY, AND MARCH OF 1974. Hurt, S. S. III; Lance, E. D. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 38p. Dep. NTIS $5.00.

The ORR operated at an average power level of 29.8 MW for 84.9% of the time during January, February, and March of 1974. Thirty-five fuel elements were declared spent (47.5% average burnup) during the quarter, while seventeen new elements were placed in service. Four shim-rod elements were retired from service at an average burnup of 66.0%. The reactor was shut down on eight occasions, all of which were scheduled. One of the scheduled shutdowns terminated a special low-power run. End-of-cycle shutdowns accounted for 91.5% of the total downtime. The remaining downtime was used principally for refueling and experiment work. Maintenance activities, both mechanical and instrument, were essentially routine in nature. Special tests or measurements completed during the quarter included: (1) void test measurement; (2) stored energy in waste experiment reactivity check; (3) fuel irradiation experiment reactivity check; (4) visual inspection of poolside facility; and (5) corrosion survey of aluminum cooling water piping for ORR. Excavation of the area around the reactor primary decay tank was in progress at the end of the quarter in preparation for removal of the decay tank for inspection and necessary repairs due to a suspected leak in the tank. (auth)

25900 (SAND-74-0150) MATERIAL PROPERTY DETERMINATION FOR FAST PULSED REACTOR FUELS BY RAPID FISSION HEATING. Reuscher, J. A.; Schmidt, T. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 3p. (CONF-741017-2). Dep. NTIS $4.00.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

A technique has been developed at Sandia Laboratories to obtain temperature-dependent thermomechanical properties of fuel materials under rapid heating conditions. The Sandia Pulsed Reactor II is used to produce a short pulse (40 to 100 μsec) of neutrons which cause rapid fission heating in a rod-shaped specimen. The dynamic behavior of the rod after heating yields data on the rod speed of sound, Young's modulus, coefficient of thermal expansion, and internal friction of the rod material. Under some conditions the yield strength of the material can also be inferred from the dynamic behavior. (auth)

25901 OPERATING EXPERIENCE WITH BELLOW FITTINGS AT THE MEHRZWECK-FORSCHUNGSREAKTOR (MZFR), KARLSRUHE. Korn, K. (Kernkraftwerk-Betriebsgesellschaft m.b.H., Leopoldshafen (F. R. Germany)). Brennst.-Waerme-Kraft; 26: No. 5, 208-211(May 1974). (In German).

8 figs.; 1 tab.; 2 refs.

The operating experience with bellow fittings at the Mehrzweck-Forschungsreaktor (MZFR) from 1966 to 1973 is reviewed with regard to specific requirements and external tightness. It has been determined by experiments to what extent the serviceable life of the bellows is influenced by a single excess beyond the limit of 1.3 times the operating pressure, as may occur in hydrostatic boiler tests. (GE)

25902 THE NEUTRON HIGH-FLUX REACTOR GRENOBLE. Brunner, A. Naturwiss. Rundsch.; 27: No. 4, 143-150(Apr 1974). (In German).

7 figs.; 3 refs.

Following an introduction into the possible uses of neutron radiation, the reactor itself and its components and auxiliary systems are described. Special emphasis is placed upon the hot and cold neutron source as well as on the neutron reflector. (GE)

25903 THE HFR AND ITS UTILIZATION. Nuecker, N.; Reichardt, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). KFK Nachr.; 5: No. 4, 1-9(1973). (In German).

10 figs.; 3 refs.

Following a brief discussion of the tasks to be accomplished by the HFR, its auxiliary and experimental systems are described, along with two time-of-flight spectrometers. Some of the experiments performed so far are also dealt with. (GE)

25904 THE TRANSPORT THEORY OF CRITICAL ASSEMBLIES WITH UNIFORM NEUTRON DISTRIBUTION. Leuthaeuser, K. D. (Institut fuer Naturwissenschaftlich-Technische Trendanalysen (INT), Stohl (F. R. Germany)). Atomkernenergie; 23: No. 3, 185-189(1974).

3 figs.; 14 refs.; 2 apps.

Some kind of inversion of the monoenergetic critical problem in transport theory is analyzed. The neutron multiplication function c(x) is evaluated for a given neutron distribution. This is achieved by application of Laplace transforms (in the case of slabs or spheres) or Hankel transforms (in cylinder geometry) to the appropriate integral equations. The transforms of c(x) are constructed by solving singular integral equations. Some numerical results are presented for slabs with uniform neutron density. (auth)

25905 REPAIR WORK IN THE OPERATING POOLS OF A SWIMMING POOL REACTOR. Henning, K.; Roebert, G. A.; Witte, R. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). Kerntechnik; 16: No. 5, 208-212(May 1974). (In German).

3 figs.; 1 tab.

This communication describes work on the repair of the beam tubes of the FRG-1 swimming pool reactor, and on the replacement of shut-off gate valves on the pool inlet and outlet sides, located in the pipework channel under the operating pools. It is shown that, in both cases, this work can be carried out without excessive radiation exposure of personnel. The work on the beam tubes was carried out underwater, by divers, in order to take advantage of the shielding effect of the pool water. The use of divers for repair work may also find applications in nuclear power stations. (auth)

25906 BORON CONCENTRATION MEASUREMENT AT THE HEAVY WATER REACTOR DIORIT. Jeschki, W.; Scheiders, C. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Kerntechnik; 16: No. 5, 213-215(May 1974). (In German, English).

4 figs.; 4 refs.

At the heavy water reactor Diorit II, excess reactivity is compensated by poisoning the moderator with boron. The very small boron concentrations (0 to 4 ppM B 10) in the heavy water are monitored with the aid of a continuous flow apparatus working on the neutron transmission principle. The monitoring apparatus is described. The measuring errors due to various factors and the correction of these errors are discussed. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 25855 and 26045.

25907 (BAW-1322) ADVANCED TEST REACTOR INTERNALS VIBRATION SUMMARY, May 1968. Manoli, R. E. (comp.). (Babcock and Wilcox Co., Lynchburg, Va. (USA). Atomic Energy Div.). Jun 1968. Contract AT(10-1)-1075. 589p. Dep. NTIS $32.50.

For Ebasco Services, Inc., New York.

The internals vibration problem in the ATR is examined. The modifications recommended are discussed, and the test data and calculation results are presented. Extensive data are presented in appendices. (JWR)

25908 (DUN-5143) CONSERVATISM OF N REACTOR DESIGN CRITERIA FOR EARTHQUAKE PROTECTION. Davis, H. S. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 10 Dec 1968. 31p. Dep. NTIS $4.75.

Earthquake criteria used in the design of the N Reactor plant are analyzed. They are compared with current AEC requirements for protecting nuclear power plants. (11 references) (auth)

25909 (DUN-5876) OPERATING CONDITIONS AND REQUIREMENTS FOR DECONTAMINATING AN N REACTOR GRAPHITE COOLING SYSTEM HEAT EXCHANGER AT BLDG. 189F. Kratzer, W. K. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 6 Jun 1969. 6p. Dep. NTIS $4.00.

The decontamination solutions, operating conditions, decontamination process, and sampling and measuring requirements for the decontamination of an N reactor graphite cooling system heat exchanger are described. (JWR)

25910 (DUN-7356) PT-N-245: N REACTOR TWO TUBE RECIRCULATING DECONTAMINATION TEST. Kratzer, W. K. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 1 Dec 1970. 19p. Dep. NTIS $4.00.

Declassified 29 Dec 1971.

The recirculating decontamination of two N Reactor process tubes containing irradiated fuel elements, and the two associated front connectors and V-11 valves is described. A decontaminating solution containing EDTA, citric acid, and hydrazine will be circulated through the two tubes at approximately 20 gallons per minute, 185 ± 5 F for up to 3 days. (auth)

25911 (DUN-7817) REAR PIPE SPACE EXTERNAL DECONTAMINATION PROGRAM: TEST RESULTS AND EVALUATION VIA DOSE RATE MODEL. Lander, W. E. B. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 3 Dec 1971. 13p. Dep. NTIS $4.00.

Radiation levels in the pipe spaces have increased steadily during operation and have placed an increasingly restrictive limitation on the repair work in those areas. Internal decontamination of the primary piping was accomplished in 1967, 1968, 1969, and 1970. The effectiveness of these decontamination efforts were comparable in terms of actual reduction but appear to be less and less effective when based on percentage reduction of the total radiation levels. The main reason for the apparent loss of effectiveness is the gradual accumulation of long-lived, activated, corrosion products in places inaccessible or semi-inaccessible to the internal decontamination solution. The list of such places would include all exterior surfaces, diversion legs, drain riser stag arms, and some interior crevices of valves, Graylocs, nozzle caps, etc. The test work presented was performed on the V-12 valves. These valves are the only major piece of hardware which can be removed from the pipe space for complete evaluation. The assumption is made that the results obtained from the V-12 valve tests can be extrapolated to the conditions of the pipe space. The two main purposes of this test work were to define that portion of the dose rate in the pipe space which is attributable to exterior contamination and define the application technique to achieve maximum removal. (auth)

25912 (DUN-7832) EXTERNAL DECONTAMINATION PROGRAM STATUS, DECEMBER 1971. Kratzer, W. K. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 14 Dec 1971. 10p. Dep. NTIS $4.00.

The development of an external decontamination procedure is effectively on schedule. The equipment and application methods are nearly finalized, and two alternate waste disposal procedures have been defined. Material compatibility questions with respect

to the Grayloc stud bolts and RTDs need to be resolved favorably before in-reactor testing can begin. The current status of the program is summarized with special emphasis on the need and scheduling of in-reactor tests. (auth)

25913 (DUN-8033) N REACTOR DECONTAMINATION, CY-1972. Final Report of Production Tests 287, 290, 295, 301, and 305. Kratzer, W. K. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 5 Sep 1972. 27p. Dep. NTIS $4.50.

During the 1972 summer maintenance outage, portions of the N Reactor primary coolant system were decontaminated to reduce personnel exposure during plant maintenance, fuel charge-discharge, and other primary system contact work. 23 references. (auth)

25914 (DUN-8134) PRODUCTION TEST N-334: 1973 N-REACTOR THROUGH-REACTOR DECONTAMINATION. Kratzer, W. K. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 26 Mar 1973. 17p. Dep. NTIS $4.00.

The N Reactor primary loop piping between the V-3 and V-4 valves will be decontaminated by a single-pass application of ~8 wt % solution of inhibited low-chloride phosphoric acid (Turco 4512-A). The cleaning solution will be introduced at 170 to 175°F into the primary loop at a reactor flow rate of ~12,000 gpm to provide a minimum acid contact time of about 25 minutes. This time may be extended by as much as 30 minutes if the safety of an interrupted flow technique can be demonstrated. 14 references. (auth)

25915 (UNI-105) PT-N-350: DECONTAMINATION OF 109N CELL PRIMARY COOLANT SYSTEM PIPING. Hall, T. M.; Kratzer, W. K. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 1 Dec 1973. Contract AT(45-1)-1857. 8p. Dep. NTIS $4.00.

The procedure for test decontamination of a 109N steam generator cell is described. (JWR)

25916 (UNI-136) LOW pH DECONTAMINATION PROCEDURE CELL 3. Wahlen, R. K. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 28 Jan 1974. Contract AT(45-1)-1857. 12p. Dep. NTIS $4.00.

A procedure for removing radioactive film from inner surfaces of primary coolant circuit piping by circulating low pH demineralized water through the steam generator and cell piping is outlined. (DG)

25917 (UNI-172) PRODUCTION TEST N-362: 1974 N-REACTOR INTERNAL DECONTAMINATION. Kratzer, W. K. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 6 May 1974. Contract AT(45-1)-1857. 16p. Dep. NTIS $4.00.

Radiation levels at the front and rear platforms and in the front and rear header spaces have increased to the point that normal operating activities and essential maintenance work in these areas are being limited by personnel radiation exposure. Similar situations in the past have been alleviated by decontaminating the reactor primary loop with a single-pass treatment of the primary loop piping with a commercial phosphoric acid cleaner, Turco-4512-A. Decontaminations by this procedure were conducted in 1967, 1968, 1969, 1970, 1972, and 1973. This production test authorizes decontamination of the N-Reactor primary loop by a procedure basically similar to the previous efforts, but modified to eliminate retained acid in the system after restoring recirculation after the decontamination. (9 references) (auth)

Propulsion and Package Reactors

Refer also to abstract 24538.

25918 (AED-C-22-14(1974)) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. Section 22. Nuclear Ship Propulsion. Number 14. Roemer, J. C. (comp.). (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Apr 1974. 47p. (In several languages). Dep. NTIS (US Sales Only) $5.50.

Citations from conferences, patents, reports, periodicals, and books are listed. Author and subject files are also provided. (JWR)

25919 (AI-AEC-12750) SNAP REACTOR PROGRAMS PROGRESS REPORT, AUGUST-OCTOBER 1968. Gylfe, J. D. (Atomics International Dfv., Canoga Park, Calif. (USA)). 15 Dec 1968. Contract AT(04-3)-701. 158p. Dep. NTIS $11.00.

Declassified 7 Sep 1973.

Progress in the following task areas is reported: (1) SNAP 8 developmental reactor testing, (2) reference zirconium hydride reactor engineering, (3) reference reactor thermoelectric system engineering, (4) compact thermoelectric converter development, (5) component development, (6) fuel development, and (7) aerospace safety. (auth)

25920 (AI-AEC-12923) SNAP REACTOR PROGRAMS PROGRESS REPORT, NOVEMBER 1969-JANUARY 1970. (Atomics International Div., Canoga Park, Calif. (USA)). 1 Apr 1970. Contract AT(04-3)-701. 167p. Dep. NTIS $11.50.

Declassified 6 Sep 1973.

Information on the SNAP reactor development programs is presented concerning SNAP 8 Developmental Reactor, reference zirconium hydride reactor engineering, reactor-thermoelectric system engineering, thermoelectric converter development, component development, fuel development, and aerospace safety. 10 references. (DCC)

25921 (ANL-6783) FINAL REPORT ON THE TESTING OF GRAPHITE-TYPE NUCLEAR ROCKET (ROVER) FUEL IN A PULSED REACTOR (TREAT). Simmons, C. R.; Yario, W. R.; Ivins, R. O. (Argonne National Lab., Ill. (USA)). May 1964. Contract W-31-109-eng-38. 94p. Dep. NTIS $7.75.

Declassified 28 Aug 1973.

This study was initiated to determine whether or not Kiwi-type fuel could be reduced by a reactor transient to particles small enough to be sufficiently consumed by burnup on re-entry to the earth's atmosphere to satisfy the safety requirements. If a severe reactor transient could reliably reduce the core of a nuclear rocket to very small particles, the safe return of the radioactive core to earth in an aborted mission could be ensured. To determine the susceptibility of the Kiwi fuel to fragmentation by a nuclear transient, autoclaved samples were subjected to transient pulses of TREAT (Transient Reactor Test Facility, NRTS, Idaho). Information such as how rapidly the power level (neutron flux) could be increased without the loss of integrity of the core material was obtained. This is valuable information in considering the reactor startup in the design requirements. In addition, the maximum power level that could be withstood by the core material during transient irradiations yielded information important in the consideration of the steady-state operating level of such a machine. The fuel material tested consisted of pyrolytic carbon-coated beads of uranium carbide in a graphite matrix. (10 references) (auth)

25922 (ANL-6842) NUCLEAR MAGNETOHYDRODYNAMIC POWER PLANT IN SPACE. Carter, J. C.; Armstrong, R. H. (Argonne National Lab., Ill. (USA)). Mar 1974. Contract W-31-109-eng-38. 57p. Dep. NTIS $6.00.

Declassified 4 Sep 1973.

A concept of a nuclear magnetohydrodynamic (MHD) generator in the megawatt range is presented here as a source of power for satellite installations and for the engines of electrically propelled rockets. The concept is based on an extrapolation of the current technology pertaining to nuclear MHD generators to that which is expected to be in existence in ten to twenty years. Nuclear fission in the solid fuel of a reactor is the initial energy conversion. The use of a conventional nuclear reactor appears feasible when the cycle fluid is a liquid metal. It is necessary to resort to nonconventional reactor designs when gas is uses as the cycle fluid. This is necessary because the gas temperatures required for acceptable generator performance are much higher than can be obrained in a solid-fuel heterogeneous reactor. The choice of a specific liquid metal is a compromise based on consideration of the effects of the physical properties of a nuclear MHD cycle upon the optimization of liquid metal temperature, velocity, pressure, and electron scattering cross section in the system. The designs of the major system components are discussed and significant figures are presented. The system efficiency is 4.6%, and the specific weight is 10.5 kg/kW(e), primarily because of the hydrodynamic losses and the amount of iron in the liquid-cooled magnets. The radiator weight is a small percentage of the total weight because of the high temperature of the reject heat. The use of high temperature throughout the system is based on the anticipated extension of technology. (auth)

25923 (ANL-6976) APPLICATION OF DIRECT NUCLEAR HEATING FOR PROPULSION IN SPACE. Rodin, M. B.; Carter, J. C. (Argonne National Lab., Ill. (USA)). Oct 1965. Contract W-31-109-eng-38. 31p. Dep. NTIS $4.75.

Declassified 28 Aug 1973.

An exploratory analysis of the phenomenon of energy conversion by the capture of a neutron in an atom of a power-transmitting medium (lithium hydride) is presented. The analysis was made within the framework of a conceptual nuclear rocket-propulsion system intended for use in a translunar environment. The unique feature of this propulsion-system concept is the capability of producing an average temperature of the propelling gas in excess of those temperatures within the fissionable material and structural components. The enthalpy of the propelling gas (lithium hydride) is increased by heat transfer from the reactor core of the rocket engine and then further increased by the capture, in the ^{6}Li isotope, of fission neutrons streaming from the core. The

results of the analysis are an estimation of the theoretical operation and characteristics of a conceptual propulsion system and an indication that interesting technical problems exist in this concept for which no precedents exist. (auth)

25924 (ANL-7236) NUCLEAR ROCKET PROGRAM TERMINAL REPORT. (Argonne National Lab., Ill. (USA)). 30 Jun 1966. W-31-109-eng-38. 198p. Dep. NTIS $13.00.

Declassified 28 Aug 1973.

Analytical studies of refractory metal fast rocket reactors have indicated that such systems can be expected to provide significantly better performance capability than could be attained with graphite-based reactors. The studies indicated that the advantages of the refractory metal system include: 1) a potential for very long operating life (in excess of 10 hr); 2) multiple restart capability at high specific impulse(800-900 sec); 3) lightness in weight and greater compactness than for comparable graphite systems. In view of the attractive characteristics of the refractory metal rocket, a detailed study of the technical feasibility and potential of this concept was undertaken, including an investigation of the advantages and limitations of the refractory metal reactor and a determination of the performance that could be expected. The major emphasis was placed upon materials research and fuel testing. Three major areas of concern were defined. These were: 1) development of a fuel-element system; 2) development of a core structure and testing of its structural integrity; 3) establishment of adequate and reliable capability for reactor control. In order to investigate these areas of concern, reference or baseline reactor designs were produced and used as models to isolate and study the effect of system-component interactions, to provide standards against which "trade-offs" could be evaluated, and to provide a means of establishing reasonable boundary conditions for various parts of the system. The first of these reference designs was a 2000-MW topping-cycle engine system sized to develop a nominal thrust of 100,000 lb. The second reference design was a 10,000-lb-thrust bleed-cycle system. The results of the fuel-element fabrication studies, which constituted a major part of the program, are equally applicable to both reference systems; however, most of the effort on component design and system analysis was expended on the 2000-MW system, which was defined in some detail. Study of the 10,000-lb-thrust system began during the latter part of the program, but considerable progress was made in the development of this design prior to the termination of the program. The reference designs represented targets for a development effort rather than complete and finalized systems. On the basis of this approach, significant progress was made toward the achievement of program objectives. A summary of the work and descriptions of the reference designs and the general program plan are inclueded. (auth)

25925 (BMFT-FBK-74-01(Vol.1)) FINAL REPORT ON AN INCORE THERMIONIC REACTOR (ITR). Volume I. Development Work and Design of a Test Facility for an Incore Thermionic Reactor (ITR): Text. (Brown, Boveri und Cie A. G., Heidelberg (F. R. Germany). Zentrales Forschungslabor; Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany); Siemens A. G., Erlangen (F. R. Germany); Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Apr 1974. 671p. (In German). Dep. NTIS (US Sales Only) $36.75.

In January 1969, a cooperation agreement was signed by Kernforschungsanlage Juelich GmbH (KFA) and the Consortium Brown Boveri, Interatom, Siemens for development, design and construction of incore thermionic reactors. The results of the development phase carried out from August 1969 until December 1972 are summarized in the fields of core layout, full scale zero power experiment, converter physics and technology, technology of metal hydride and driver fuel elements, sodium technology, metallurgy, inpile tests with driver and converter cells, and also in the field of planning and design of a reactor test facility including the incore thermionic reactor for 20 kW electrical power output. (auth)

25926 (BMFT-FBK-74-01(Vol.2)) FINAL REPORT ON AN INCORE THERMIONIC REACTOR (ITR). Volume II. Development Work and Design of a Test Facility for an Incore Thermionic Reactor (ITR): Tables and Figures. (Brown, Boveri und Cie A. G., Heidelberg (F. R. Germany). Zentrales Forschungslabor; Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany); Siemens A. G., Erlangen (F. R. Germany); Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Apr 1974. 480p. (In German). Dep. NTIS (US Sales Only) $27.00.

25927 (GKSS-74/E/21) NUCLEAR SHIP PROPULSION IN THE FEDERAL REPUBLIC OF GERMANY. Schroeder, E.; Ulken, D. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany)). 1974. 21p. (CONF-731148-1). Dep. NTIS (US Sales Only) $4.25.

From ISME symposium; Tokyo, Japan (13 Nov 1973).

The development program for nuclear ship propulsion in the Federal Republic of Germany is described. The design work is concentrated on a nuclear container ship of 80,000 shp, which should be built from 1975 onwards. An economic comparison with a similar ship, but oil-fired, is given. (auth)

25928 (IKE-6-83DE) RADIATION SHIELDING FOR SPACE PROPULSION REACTORS. Tsotsis, G. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Mar 1974. 57p. (In German). INIS.

29 figs.; 7 tabs.; 6 refs. Available from the library of Stuttgart Univ.

Materials suited for gamma and neutron shielding of a high-temperature reactor, to be used as a power source in space vehicles, are described. One and two-dimensional S_N calculations show that for gamma shielding, a tungsten shield near the axial reflector should be used. For neutron shielding, the best choice is a combination of YH_x with B_4C or ZrH_x with B_4C. (GE)

Reactor Safety and Environmental Aspects

Refer also to abstracts 23975, 23978, 23979, 23990, 24021, 24028, 24372, 24389, 24778, 25886, and 26046.

25929 (ANCR-1151) EXPERIMENT DATA REPORT FOR SEMISCALE SYSTEM COUNTERCURRENT FLOW TESTS. Naff, S. A.; Alder, R. S.; Pinson, P. A. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jun 1974. Contract AT(10-1)-1375. 399p. Dep. NTIS $10.60.

Gas-liquid countercurrent flow tests were performed as part of the Semiscale Blowdown and Emergency Core Cooling (ECC) Project. These tests included: (a) preliminary tests to establish the lower plenum liquid level for subsequent tests and to investigate bypass flow phenomena; (b) steady state tests to investigate the relation between steam flow and ECC entrainment; and (c) transient tests to investigate the effect of steam generation and high wall heat flux on countercurrent flow behavior. The tests were conducted using the semiscale vessel, a phase separator, and a storage tank. Results are presented as dimensionless volumetric flux graphs, computer printout of digital data at discrete time intervals, and computer-produced graphs of analog data as a function of time. Descriptions of the test facility, instrumentation, operating procedures, and test conditions are presented. Maximum errors are identified and an error analysis is presented for the volumetric flux presentations. The data are presented with minimum interpretation for use by the nuclear community and for support of subsequent interpretative analyses. (auth)

25930 (ANCR-1152) EXPERIMENT DATA REPORT FOR 1-1/2-LOOP SEMISCALE SYSTEM ISOTHERMAL TEST 1009. Feldman, E. M. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jun 1974. Contract AT(10-1)-1375. 62p. Dep. NTIS $5.45.

Recorded test data are presented for Test 1009 of the isothermal portion of the Semiscale Blowdown and Emergency Core Cooling (ECC) Project. These data represent the results of the first isothermal test utilizing an enlarged downcomer gap (1.69 inches) in the pressure vessel to investigate general system hydraulic response with simulated ECC injection. The data, presented in the form of composite graphs in engineering units, have been analyzed only to the extent necessary to assure that they are reasonable and correct. The intent of this report is to make available the uninterpreted data from Test 1009 for use by others and for support of subsequent interpretive reports and analysis. (auth)

25931 (ANCR-1161) ECC PERFORMANCE IN THE SEMISCALE GEOMETRY. Hanson, D. J.; Cartmill, C. E.; Perkins, K. R.; Shaffer, C. J.; Snider, D. M. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jun 1974. Contract AT(10-1)-1375. 194p. Dep. NTIS $7.60.

Selected experimental data from ECC investigations performed as part of the Semiscale Blowdown and Emergency Core Cooling (ECC) Project are analyzed. The analysis is confined to data that describe ECC-related phenomena in the cold leg, upper annulus, downcomer, and lower plenum because these components represent the path the ECC must follow to reach a position where cooling of a core could result. The semiscale project data and the analysis presented in this report are valuable for evaluating the adequacy and improving the predictive capability of analytical models developed to predict system response and ECC behavior during a postulated loss-of-coolant accident in a pressurized water reactor. (auth)

25932 (ANL-8105) PARAMETRIC STUDY OF PRESSURE GENERATION AND SODIUM-SLUG ENERGY FROM MOLTEN-

FUEL-COOLANT INTERACTIONS. Cho, D. H.; Chen, W. L.; Wright, R. W. (Argonne National Lab., Ill. (USA)). Aug 1974. Contract W-31-109-eng-38. 21p. Dep. NTIS $4.00.

A parametric study was performed using a rate-limited model of molten-fuel-coolant interactions previously developed. A 2-ft-long molten zone across the FFTF core was considered, in which 1250 kg of molten fuel at 3400°K was mixed with 196 kg of sodium at 922°K. A few less severe cases were examined as part of the parameter variations. The effects of variations in system parameters upon pressure-time histories and sodium-slug energies were investigated. The process of sodium heating by the fuel was reformulated in order to take into account a finite rate of fragmentation and mixing. (auth)

25933 (BAW-10091) B AND W'S ECCS EVALUATION MODEL REPORT WITH SPECIFIC APPLICATION TO 177 FA CLASS PLANTS WITH LOWERED LOOP ARRANGEMENT. Dunn, B. M.; Cartin, L. R.; Jones, R. C.; Parks, C. E.; Salm, R. J. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Aug 1974. 218p.

The guidelines for evaluating the loss-of-coolant accident for all B&W NSSs are developed and compared with the guides presented in Appendix K of the Code of Federal Regulations, 10 CFR 50. These guides are then applied to the 177-fuel assembly, lowered-loop NSS showing that these plants meet all the requirements of the acceptance criteria of 10 CFR 50. Technical specifications for operation of the plants, with regard to maximum allowable heating rates, are developed and reported. (auth)

25934 (BAW-10092) CRAFT2: FORTRAN PROGRAM FOR DIGITAL SIMULATION OF A MULTINODE REACTOR PLANT DURING LOSS OF COOLANT. Topical Report. Hedrick, R. A.; Cudlin, J. J.; Foltz, R. C. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jul 1974. 110p.

The CRAFT2 program calculates the transient response of a water reactor to a loss-of-coolant. The numerical integrations are made serially by a combination of forward differencing and implicit techniques. Fluid properties are obtained from tables based on the 1967 ASME steam equations. Unusual features of the program include multiple time-step analysis, restart capability, plot capability, implicit solution technique. The program is written in FORTRAN IV for the CDC 7600 computer. (auth)

25935 (BAW-10093) REFLOOD: DESCRIPTION OF MODEL FOR MULTINODE CORE REFLOOD ANALYSIS. Bingham, B. E.; Shieh, K. C. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jul 1974. 78p.

In compliance with AEC's "Interim Acceptance Criteria for Emergency Core Cooling System for Light-Water-Cooled Power Reactors" published on June 29, 1971, B&W developed the REFLOOD computer program for analyzing core refill and reflood transients following a loss-of-coolant accident. This program was documented and reported in the topical reports BAW-10031 and BAW-10031-Supp. 1. Following the rulemaking hearing on "Acceptance Criteria for Emergency Core Cooling Systems for Light-Water-Cooled Nuclear Power Reactors," the Atomic Energy Commission modified its Interim Acceptance Criteria and published the New Acceptance Criteria for Emergency Core Cooling Systems on December 28, 1973. The original REFLOOD code has been modified to comply with the new rule, and this report provides a theoretical description of the code. (auth)

25936 (BAW-10094) BABCOCK AND WILCOX REVISIONS DATED 6/13/74 to THETA1-B, A COMPUTER CODE FOR NUCLEAR REACTOR CORE THERMAL ANALYSIS: IN-1445 AS PUBLISHED FEBRUARY 1971. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jul 1974. 102p.

A digital computer code, THETA1-B, was developed to study the thermal response characteristics of a nuclear fuel rod subjected to a postulated loss-of-coolant accident environment. This code was developed as part of the Loss-of-Coolant Accident Analysis Program currently being conducted at the National Reactor Testing Station by Idaho Nuclear Corporation for the Atomic Energy Commission. The energy equations for both the fuel rod and the adjacent fluid channel are solved. A heat transfer model is employed to link the solutions of the two energy equations. This model has been developed on the basis of heat transfer correlations available in the open literature. The code has the capability of modeling electrically heated test elements. This feature allows the postulated heat transfer model to be evaluated in terms of experimental heat transfer data obtained during decompression tests. (auth)

25937 (BAW-10095) BABCOCK AND WILCOX REVISIONS TO CONTEMPT, COMPUTER PROGRAM FOR PREDICTING CONTAINMENT PRESSURE-TEMPERATURE RESPONSE TO A LOSS-OF-COOLANT ACCIDENT. Hsii, Y. H. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jul 1974. 54p.

The CONTEMPT computer program predicts the pressure-temperature response of a single-volume reactor building to a loss-of-coolant accident. The analytical model used for the program is described. CONTEMPT assumes that the loss-of-coolant accident can be separated into two phases; the primary system blowdown and reactor building pressurization. The results of the blowdown analysis serve as the boundary conditions and are input to the CONTEMPT program. Thus, the containment model is only concerned with the pressure and temperature in the reactor building and the temperature distribution through the reactor building structures. The user is required to input the description of the discharge of coolant, the boiling of residual water by reactor decay heat, the superheating of steam passing through the core, and metal-water reactions. The reactor building is separated into liquid and vapor regions. Each region is in thermal equilibrium itself, but the two may not be in thermal equilibrium; the liquid and gaseous regions may have different temperatures. The reactor building is represented as consisting of several heat-conducting structures whose thermal behavior can be described by the one-dimensional multi-region heat conduction equation. The program also calculates building leakage and the effects of engineered safety features such as reactor building sprays, decay heat coolers, sump coolers, etc. (auth)

25938 (BMI-X-654) BIOENVIRONMENTAL EFFECTS ASSOCIATED WITH NUCLEAR POWER PLANTS; A SELECTED BIBLIOGRAPHY. First Addendum. Mayer, R.; Jefferis, J.; Major, S.; Davidson, R. S. (Battelle Columbus Labs., Ohio (USA)). 30 Jun 1974. Contract W-7405-eng-92. 402p. Dep. NTIS $23.25.

Abstracts, a keyword index, and an author index are provided for publications concerning bioenvironmental effects of nuclear power plants. (JWR)

25939 (BNWL-B-298) MIXING OF BUOYANT COMBUSTIBLE GASES IN BWR CONTAINMENT SYSTEMS. Trent, D. S. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1973. Contract AT(45-1)-1830. 29p. Dep. NTIS $4.50.

The calculation of convection currents and concentration distributions of hydrogen/oxygen in the pressure suppression chamber of a BWR following a loss-of-coolant accident is discussed. The theoretical background, the computer program developed, and some test results are presented. (JWR)

25940 (BNWL-B-348) RATE OF DISSOLUTION OF FUEL PARTICLES IN MOLTEN FLOOR MATERIAL AFTER A FAST REACTOR CORE MELTDOWN. Herbst, M. J.; Jansen, G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-1830. 41p. Dep. NTIS $5.25.

Models have been developed to predict the rate of dissolution of self-heating fast reactor fuel particles in large pools of molten floor materials. Calculations were made with simultaneous heat, mass and momentum transfer for free convection around a stationary particle, forced convection around a particle settling at its terminal velocity, and for particles which penetrate the floor of the molten pool. The results do not support an unconditional assumption of quick dissolution of UO_2 in molten basalt, but if the particles are of sufficiently small size, and the viscosity is low enough, and the pool temperature is high enough the assumption is approached. Appreciable depths of penetration of the pool floor by resting particles were predicted. The numerical results are completely dependent on an arbitrarily guessed value of the diffusion coefficient for UO_2 in molten basalt. There is a need for data on fuel solubility, melt viscosity, diffusion coefficient, and rate of dissolution in molten ceramics. The solubility and rate of dissolution of UO_2 in molten floor materials would be significantly increased by lowering the melt viscosity and introducing additives. (20 references) (auth)

25941 (BNWL-SA-4952) QUANTIFIED SOCIAL AND AESTHETIC VALUES IN ENVIRONMENTAL DECISION MAKING. Burnham, J. B.; Nealey, S. M.; Jones, G. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 6p. (CONF-740907-1). Dep. NTIS $4.00.

From symposium on the siting of nuclear facilities; Bordeaux, France (2 Sep 1974).

There exists a major dilemma in environmental decision making in that the analytical methodology does not include measured community values nor does it quantify all environmental impacts. A system has been devised for combining, in the design stage, societal judgments with techno-economic assessments of alternatives. The system utilizes measured social values in a decision matrix as weighting factors for each of eight selection criteria.

The eight criteria are analyzed independently by techno-economic methods for each alternative. The weighted scores are summed to arrive at a composite score. Social psychologists helped to derive the criteria by a review of environmental literature including intervenors' statements. The eight criteria selected were: aesthetic impact, land use, water impact, air impact, economic, cultural/recreational, health/safety, and ecological impact. The social psychologists designed a questionnaire survey which measures, both by direct and indirect methods, community judgments on the relative importance of the eight criteria. Three distinct groups of respondents were used to test the method. The groups and the number of analyzable responses from each were: environmentalists (91), high school students (57), and businessmen (29). The response patterns from all three were markedly similar but with a bias of the businessmen toward nuclear power, the environmentalists against, and the high school students between the two. A Seattle firm of landscape architects, Jones and Jones, devised a system in which aesthetics is reduced to its component features of intactness, vividness, and unity. Methods were devised for selecting (from projections on a topographic map) viewpoints of a potential plant site, for portraying the visual effect of a plant design on a site, and for the grading of the change in visual quality with the "addition" of the plant. Factors were also derived analytically for the effect of the number of visual contacts, both resident and transient. A peer group of urban planners and landscape architects used the technique to analyze three nuclear plant viewscapes — two at the Trojan site and one at Rancho Seco. (auth)

25942 (COO-2286-3) DESIGN BASIS ACCIDENT STUDIES. Final Report. Nicholson, R. B. (Ohio State Univ., Columbus (USA)). 22 Jun 1974. Contract AT(11-1)-2286. 266p. Dep. NTIS $16.50.

An extension of the ANL equation of state in the VENUS-II program to include lower pressure conditions and an isentropic expansion calculation shows that the energy available for mechanical damage is strongly dependent upon how far the expansion can proceed. Expansion to one atmosphere in weak accidents can lead to one to two orders of magnitude more energy than R. W. Stratton's eight-fold volume expansion. The modified Bethe–Tait method of Edwards and Mather is approximately reproduced and verified but at high Doppler effect, low excursion energy conditions, the ANL equation of state in VENUS leads to significantly greater energy release. A potentially autocatalytic effect, associated with neutron streaming through voids, (first discussed by Richard Webb), cannot be disregarded in HCDA analysis. More work is required to establish its quantitative significance. Most of the SAS-2A computer program modeling is found to be based on sound principles. There is general agreement with ANL on the few weaknesses of the modeling. The DBA concept as a basis for breeder containment design is found to be a sound concept when accompanied by a commitment to provide the highest practicable containment capacity and by a commitment to assure responsibility and visibility in containment design decisions. (auth)

25943 (GA-A-12868) CORCON: A PROGRAM FOR ANALYSIS OF HTGR CORE HEATUP TRANSIENTS. Schwartztrauber, K. E.; Silady, F. A. (General Atomic Co., San Diego, Calif. (USA)). 15 Jul 1974. 58p. (GA-LTR-13).

The computer program CORCON was developed to calculate the transient core temperatures during a post-reactor-trip HTGR core heatup event with a hypothetical absence of forced circulation. These temperatures are necessary to calculate the transient fission product release during the maximum hypothetical fission product release event upon which subsequent environmental dose calculations are based. CORCON simulates the conductive and radiative heat transfer processes by a transient solution to the finite difference two-dimensional energy balance equations. Material properties may be specified as functions of temperature, time, and space. The core is modeled by homogenizing the rings of hexagonal refueling regions and using composite core properties. Special features of CORCON include the capability to account for (1) heat generation and redistribution of decaying fission products and (2) radiative heat transfer to core outlet and inlet plenums. (auth)

25944 (GEAP-10207-30) REACTOR PRIMARY COOLANT SYSTEM PIPE RUPTURE STUDY. Progress Report No. 30, July–December 1973. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Mar 1974. Contract AT(04-3)-189. 46p. Dep. NTIS $4.00.

The pipe rupture study is designed to extend the understanding of failure-causing mechanisms and to provide improved capability for evaluating reactor piping systems to minimize the probability of failures. Following a detailed review to determine the effort most needed to improve nuclear system piping (Phase I), analytical and experimental efforts (Phase II) were started in 1965. This progress report summarizes the recent accomplishments of a broad program in (a) fatigue studies through both bench-scale and large-component tests, (b) at-reactor tests of the effect of primary coolant environment on the fatigue behavior of piping steels, and (c) failure probability study of actual reactor piping systems. (auth)

25945 (GEAP-13317-06) BWR BLOWDOWN HEAT TRANSFER. Sixth Quarterly Progress Report, October 1–December 31, 1973. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div.). Dec 1973. Contract AT(04-3)-189. 60p. Dep. NTIS $5.45.

The test plan proposed for 49-rod bundles has been completed and reviewed with the US AEC. The data from the second 16-rod bundle has been evaluated, and the effects of test parameter variations are shown. Internal orifices for the core and core bypass flow paths have been sized and calibrated using an ambient pressure, flow mockup vessel. Drive loop orifices and the jet pump diffusers were also calibrated. The Two Loop Test Apparatus (TLTA) high-pressure piping has been installed, and the internals were transferred from the flow mockup vessel to the TLTA. Shakedown testing of the TLTA has been started. The Preliminary System Design Description has been expanded and revised, and "as-built" drawings have been completed. (auth)

25946 (KFK-1827) INVESTIGATION OF SPECTRAL SYNTHESIS AND FEW GROUP METHODS FOR FAST REACTOR TRANSIENTS. Terney, W. B.; Srivenkatesan, R. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Jul 1973. 62p. Dep. NTIS (US Sales Only) $6.25.

Two methods of calculating fast reactor transients economically are considered: the energy synthesis method and the few group schemes. Two transients of interest for safety studies were considered for a simple representative one dimensional fast reactor model. These were a partial voiding transient and a complete voiding and fuel slumping transient. The energy synthesis method gave excellent agreement both statistically and transiently with the exact 26 groups results. Only 3 trial functions were used: the unperturbed core and blanket and the perturbed core averaged flux spectra. The weighting functions were their corresponding adjoints. In few group schemes normal flux weighted collapsing and bilinear (flux-adjoint) collapsing were considered. The flux weighted procedure did not give satisfactory results even with up to 12 groups. However the bilinear flux-adjoint schemes give satisfactory results with only 6 to 8 groups when the unperturbed flux and perturbed adjoint spectra (or vice versa) were used. For cases where the reactivity effects are not so sensitive (away from one dollar), acceptable results were obtained with just the unperturbed fluxes and adjoints. With bilinear collapsing it is necessary to consider discontinuities arising at interfaces between regions where the flux and adjoint-spectra are different. This requires the current conditions to be modified at such interfaces, while the normal few group flux continuity is sufficient. (auth)

25947 (KFK-1881) INFLUENCE OF THE PROMPT NEUTRON GENERATION TIME ON THE SAFETY OF REACTORS. Thurnay, K. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. Fuer Neutronenphysik und Reaktortechnik). Nov 1973. 22p. (In German). Dep. NTIS (US Sales Only) $4.00.

An attempt is made to determine if an increase in the prompt neutron generation time can make a given nuclear reactor more or less safe in the case of an eventual accident. The calculations show that for small accidents the reactor safety is not significally influenced by the generation time. In the case of large, uncontrolled accidents an increase in the generation time makes a reactor less safe, by increasing the destructive energy produced. (auth)

25948 (KFK-1895) MODEL TESTS FOR THE EMERGENCY COOLING SYSTEM OF THE PROTOTYPE REACTOR SNR 300. Hain, H.; Hofmann, F.; Kirsch, D.; Kleefeldt, K.; Kramer, W.; Meyder, R. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Jun 1974. 200p. (In German). Dep. NTIS (US Sales Only) $13.00.

The emergency cooling system of the sodium cooled fast prototype reactor SNR 300 was designed to remove the afterheat in certain incidents which, although they are highly unlikely, cannot be left out of consideration in safety assessments. The incident considered is a pipe rupture of the pump pressure pipe coupled with a failure of the pump shutdown system. In this case, the emergency cooling concept is based upon natural convection inside the tank generated by heat added in the core and a heat sink consisting of immersion coolers attached to the inside of the tank. This cooling circuit within the tank is covered by a computer program (NOTUNG) drafted by the Interatom company for a theoretical model describing the thermodynamic behavior of the circuit. The test rig is a rather detailed reconstruction of the reactor tank and

its internals on a longitudinal scale of 1:3, but limited to a 120 degree section. Water was used as the coolant. The fuel and blanket elements were simulated by electrically heated rod bundles, mostly with seven rods; radial power variation in the core and the decrease of power with time were selected on the basis of reactor conditions during the incident. The data produced by an extensive measuring setup were acquired and processed by an electronic system. Test results show that natural convection starts in the desired way within a few seconds after the heating power is turned on ($\tau = 0$) as core flow and core outlet temperature increase rapidly. Shortly after the first power reduction, at $\tau = 100$ sec, the core flow settles at a plateau level, while the outlet temperature passes through a first peak and continues to rise slightly up to the second power decrease ($\tau = 1000$ sec). Afterwards, these quantities decrease and the critical phase to the reactor is over if events in the reactor proceed in the same way. To allow a comparison to be made between the calculation and the experiment for several system conditions, and also to obtain a direct measurement of the response of the system to certain variations, the following test parameters were varied in a total of 25 experiments: heating power, immersion cooler capacity, heating power transient, blanket power, several cross section reductions, filling level, and initial temperature. On the whole, it can be said that the computer program used is a good representation of the dynamic behavior of the system. In those instances in which there are discrepancies in absolute values, the program is on the safe side as far as the model concept employed is concerned. An investigation of the similarity problem within the framework of a feasibility study indicated that the determinant dimensionless groups are different in these model scale tests with water from those associated with the SNR 300 reactor by several orders of magnitude. Hence, no direct transfer of results in the sense of the theory of similarity is possible. However, the experiments demonstrated that heat removal by natural convection is possible in a flow pattern as complicated as in this case and that, because of the good representation of the global behavior of the system by the computer program, this program may be assumed also to give a correct representation of the conditions associated with emergency cooling in the reactor. (auth)

25949 (NERC-LV-539-6) NRDS NUCLEAR ROCKET EFFLUENT PROGRAM, 1959–1970. Bernhardt, D. E.; Evans, R. B.; Grossman, R. F.; Buch, F. N.; Carter, M. W. (National Environmental Research Center, Las Vegas, Nev. (USA)). Jun 1974. Contract AT(26-1)-539. 154p. Dep. NTIS $5.45.

The health implications of radioactive effluent released during nuclear rocket engine tests at the Nuclear Rocket Development Station (NRDS), Jackass Flats, Nevada, prior to 1970 are reviewed. During this period, nuclear rocket engine concepts incorporated an open-cycle hydrogen-cooled reactor with core operating temperatures of approximately 4,000°F, which cause small quantities of fission products to migrate from the fuel and to be released in the rocket engine exhaust as gases or micrometer-sized particulates; radioactivity released in this manner is called the "aerosol effluent." Core operating conditions caused minor fuel element erosion and corrosion, releasing particles with high radioactivity content (roughly 10^{11} fission per particle) and diameters of tens of micrometers; these particles are referred to as the "particulate effluent." NRDS adjoins the Nevada Test Site and the Nellis Air Force Range and is located about 80 miles northwest of Las Vegas, Nevada, in an area of low population density and limited agricultural usage. Lathrop Wells (population less than 100), the nearest town, is about 15 miles from the testing locations. Estimates of doses, both potential and actual, resulting from exposure of the off-site population to aerosol effluent from past tests have been 15% or less of the appropriate Federal Radiation Council (FRC) guides and Atomic Energy Commission (AEC) standards. Possible modes of interaction of the particulate effluent with humans which have been investigated include deposition of particles on skin, in or near the eye, in the respiratory system, and in the GI tract. The most limiting mode of interaction, considering biological consequences and probability of occurrence, appears to be deposition on skin. There are no AEC or FRC guides or standards applicable to this type exposure, but the testing organization with the assistance of consultants has established an operational guide. The guide stipulates that the probability of a deleterious interaction (defined as a certain dose to the skin) should be less than 10^{-4}. Several tests have resulted in potential probabilities of interaction near or above this guide in off-site unpopulated areas. However, there are no known instances of interaction of the particulate effluent with individuals in the off-site population. (auth)

25950 (NP-20022) ENVIRONMENTAL CONSEQUENCES OF NUCLEAR AND CONVENTIONAL EXTENSION OF POWER PLANTS. A Statement Submitted to the Ministry of Commerce, Shipping, and Industry by the Energy Committee of the Power Plants. (Handelsministeriet, Copenhagen (Denmark)). Mar 1974. 17p. (In Danish). Dep. NTIS (U. S. Sales Only) $4.00.

The environmental aspects are treated as seen from the year 1990 and include air pollution, thermal release, water pollution, safety, waste, transport and noise. The manpower needed for construction and running of plants is calculated, the size of the area required and the aesthetics are touched upon, and finally decommissioning is treated. The conclusion is that nuclear power plants must be considered as being the soundest solution environmentally, but that, with present design and operation, conventional as well as nuclear power plant types must be considered rational and usable. (DE)

25951 (NP-20024) SITING POSSIBILITIES FOR NUCLEAR POWER PLANTS IN DENMARK WEST OF THE GREAT BELT. A Review by the Working Group Set Up by the Ministry of the Environment to Consider the Siting of Nuclear Power Plants. (Miljoeministeriet, Copenhagen (Denmark)). Jan 1974. 42p. (In Danish). Dep. NTIS (U. S. Sales Only) $5.25.

A working group set up by the Danish Ministry of the Environment and with representatives from other ministries which will be involved in the final approval of the siting of nuclear power plants has, on the basis of an application from the electrical power group Elsam, evaluated 45 possible sites proposed by Elsam for nuclear power plants in the Jutland–Funen area. The evaluation of the sites has been based on such factors as alternative use, population distribution, location of recreational areas, distances to existing power grids, possible use of waste heat for district heating, and thermal pollution. The working group proposes that 9 of the 45 sites shall be reserved for the purpose, and further building activity out to a distance of 10 km from the sites shall be subject to regulations. (DE)

25952 (NP-20105) PRELIMINARY PREDICTIONS OF THE FIRST PHASE OF THE PRESSURE SUPPRESSION TEST FACILITY WITH KEY ASSUMPTIONS AND INITIAL CONDITIONS. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div.). 27 Nov 1973. 51p.

A summary of pretest predictions, analyses input assumptions, requested transient results, and initial analytical conditions is presented. (JWR)

25953 (NP-20112) ANNUAL REPORT, 1973. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). 1973. 119p. (In German). Dep. NTIS (US Sales Only) $9.00.

The organization and administration of the Institute for Reactor Safety are described, and its role and activities in the nuclear industry of the German Federal Republic are reported. (DG)

25954 (ORNL-TM-4655(Vol.III)) QUARTERLY PROGRESS REPORT ON REACTOR SAFETY PROGRAMS, SPONSORED BY THE DIVISION OF REACTOR SAFETY RESEARCH, FOR APRIL–JUNE 1974. III. Liquid-Metal-Cooled Fast Breeder Reactor Safety. Fontana, M. H. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 45p. Dep. NTIS $4.00.

Work for the quarter included the development of programs for studies of transient release from LMFBR fuels and effects of sodium spills on steel-lined equipment cells. (JWR)

25955 (PB-228102/0) STOCHASTIC DECISION MAKING APPLIED TO NUCLEAR REACTOR SAFETY. Schleicher, R. W. (Cornell Univ., Ithaca, N. Y. (USA)). Aug 1972. 146p. (NSF-RA/N-72-021). NTIS $10.50.

A methodology is proposed for making optimum engineering decisions regarding the design and operation of a nuclear power plant with respect to public safety. By using the principle of stochastic decision making, an optimum safety strategy may be determined by a quantitative trade-off between the economic cost, a deterministic function of the design and operating procedures; and the risk, a quantitative measure of safety which is the expectation value over the random occurrences of accidental consequences. (auth)

25956 (SWND-2(Suppl. 2)) LOCTVS: A COMPUTER CODE TO DETERMINE THE PRESSURE AND TEMPERATURE RESPONSE OF PRESSURE SUPPRESSION CONTAINMENTS TO A LOSS-OF-COOLANT ACCIDENT. (Stone and Webster Engineering Corp., Boston, Mass. (USA)). May 1974. 43p.

The vent clearing model used in LOCTVS for horizontal vent vapor suppression containments is presented along with the supporting assumptions, nodal configuration, and derivation of equations. Following a loss of coolant accident, the rising pressure in the drywell depresses the water level within the annulus between the weir wall and the drywell wall. As each row of vents uncovers, it is cleared of water and a mixture of steam, air and liquid is thereby permitted to flow from the drywell into the suppression pool. The rate at which the annulus and vents clear is

a function of the pressure buildup in the drywell, the vent geometry, and the vent loss coefficients. The drywell pressure, prior to vent flow, is determined by reactor system blowdown and the drywell free volume. The model for calculating the drywell thermodynamic state is described in SWND-2. After vents have cleared, the drywell pressure transient is affected by vent flow. The analytical model for vent flow is based on a homogeneous model and is described in SWND-2, Supplement 1. The vent configuration is dependent upon the particular plant and is an input to LOCTVS. The pressure loss coefficients are experimentally derived and will be verified by data from GE's Mark III test program. (auth)

25957 (UCLA-ENG-7362) TRANSIENT ANALYSIS OF LMFBR OXIDE FUEL ELEMENTS DURING ACCIDENTS. 2. Technical Report. Final Report, 1 July 1972-30 June 1973. Erdmann, R. C. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jul 1973. Contract AT(04-3)-34. 316p. (UCLA-34P203-1A). Dep. NTIS $19.00.

The results of research at UCLA from July 1972 through June 1973 on transient fast reactor fuel element behavior are presented. The research covered fission gas behavior, a review of TREAT experiments on fuel failure location and subsequent fuel coolant dynamics, fuel behavior during flow coast-down accidents, and fuel behavior due to constituents other than fission gas. (JWR)

25958 (WASH-1233) REVIEW OF ORGANIC IODIDE FORMATION UNDER ACCIDENT CONDITIONS IN WATER-COOLED REACTORS. Postma, A. K.; Zavadoski, R. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1972. 71p. GPO $0.65.

The objective of this study was to determine from available information the degree to which organic iodides could form within the containment system of a light water reactor following a design basis loss of coolant accident. From an analysis of 69 containment experiments, it was concluded that less than 1% of iodine initially airborne (initial concentration of 100 mg/M^3) could become converted to organic iodides by non-radiolytic means. Radiolysis experiments showed that gas phase radiolytic formation would add no more than 2.2% to the conversion indicated by containment experiments. Overall, no more than 3.2% of airborne iodine (airborne mass assumed equal to 25% of maximum core inventory) could be converted to organic iodides during the first two hours following fission product release. This percentage conversion to organic iodides is considered a conservative upper bound figure. In reality, much less organic-bound iodine would very likely be formed and the 3.2% conversion figure should be lowered as new information justifies. (auth)

25959 (WASH-1327(Vol.1)(Draft)) GESMO: GENERIC ENVIRONMENTAL STATEMENT ON THE USE OF RECYCLE PLUTONIUM IN MIXED OXIDE FUEL IN LWR'S. Volume 1. Summary and Conclusions. (USAEC Directorate of Licensing, Washington, D.C.). Aug 1974. 110p. Dep. NTIS $8.50.

Information on the environmental considerations of using recycle plutonium in BWR and PWR reactor fuels is summarized under the following headings: background and experience in plutonium recycle; projection of nuclear industry; environmental consequences of plutonium recycle; considerations of effects of plutonium recycle on materials and plant protection; summary of probable adverse environmental effects and mitigating actions which might be taken; and alternative dispositions of plutonium and cost benefit analysis. (DCC)

25960 (WASH-1327(Vol.2)(Draft)) GESMO: GENERIC ENVIRONMENTAL STATEMENT ON THE USE OF RECYCLE PLUTONIUM IN MIXED OXIDE FUEL IN LWR'S. Volume 2. Chapters I, II, III. (USAEC Directorate of Licensing, Washington, D.C.). Aug 1974. 153p. Dep. NTIS $10.75.

Information on the environmental considerations of using recycle plutonium in BWR and PWR reactor fuels is presented concerning the background and experience with plutonium, and the projected plutonium recycle industry. (DCC)

25961 (WASH-1327(Vol.3)(Draft)) GESMO: GENERIC ENVIRONMENTAL STATEMENT ON THE USE OF RECYCLE PLUTONIUM IN MIXED OXIDE FUEL IN LWR'S. Volume 3. Chapter IV. (USAEC Directorate of Licensing, Washington, D. C.). Aug 1974. 539p. Dep. NTIS $30.00.

Information on the environmental considerations of using recycle plutonium in BWR and PWR reactor fuels is presented concerning the light water reactor with plutonium, mixed oxide fuel fabrication, reprocessing plant operations, supporting uranium fuel cycle, transportation of radioactive materials, radioactive waste management, storage of plutonium, and radiological health assessment. (DCC)

25962 (WASH-1327(Vol.4)(Draft)) GESCO: GENERIC ENVIRONMENTAL STATEMENT ON THE USE OF RECYCLE PLUTONIUM IN MIXED OXIDE FUEL IN LWR'S. Volume 4. Chapters V, VI, VII, VIII, IX, X, XI. (USAEC Directorate of Licensing, Washington, D. C.). Aug 1974. 282p. Dep. NTIS $17.25.

Information on the environmental considerations of using recycle plutonium in BWR and PWR reactor fuels is presented concerning materials and plant protection, probable adverse effects which cannot be avoided, alternative dispositions of plutonium, relationship between local short-term use of man's environment and the maintenance and enhancement of long-term productivity, irreversible and irretrievable commitments of resources, and cost benefit analysis of alternative dispositions of plutonium. (DCC)

25963 (WASH-1329) REVIEW OF MATHEMATICAL MODELS FOR PREDICTING SPRAY REMOVAL OF FISSION PRODUCTS IN REACTOR CONTAINMENT VESSELS. Postma, A. K.; Pasedag, W. F. (USAEC Directorate of Licensing, Washington, D. C.). 15 Jun 1973. 81p. Dep. NTIS $5.45.

Mathematical models for predicting the removal rate of fission products by sprays in PWR containment vessels have been examined in detail. The scope of the present study has included the removal of elemental iodine organic iodides and aerosol particles by sprays of several compositions. These include boric acid, basic borax at a pH of 9.5, and basic borax containing 1% by weight of sodium thiosulfate. The purpose of the study was to evaluate an existing spray model used by AEC and to note potential areas for improvement. From the work completed it was concluded that the previous model yielded conservative predictions of iodine washout, but that a number of improvements could be made to make the model more realistic. Areas in which improvements were suggested include: (1) an accounting for drop saturation effects, (2) use of experimentally determined partition coefficients, (3) use of a drop size distribution in place of a mean size, (4) improvement in the drop coalescence model, (5) development of a mechanistic model for methyl iodide removal, (6) use of more realistic drop collection efficiencies for predicting particle washout, (7) more rigorous treatment of multi-compartment containments, (8) an improved analysis of spray aerosolization, and (9) modification in the cut-off concentration to reflect long term behavior. (auth)

25964 (WASH-1330) TECHNICAL REPORT ON DENSIFICATION OF WESTINGHOUSE PWR FUEL. (USAEC Regulatory Staff, Washington, D. C.). 14 May 1974. 26p. Dep. NTIS $4.50.

The Westinghouse Fuel Densification and Power Spike Models as described in WCAP-8218 have been reviewed by the Staff. These models were found to be acceptable for the evaluation of densification effects in pressurized PWR fuels that have been manufactured within the processing bounds as described in WCAP-8218. Where the Westinghouse Densification Model predicts a fuel geometric density in excess of 96.5% theoretical density, the Staff approves the option to use the lower density value, i.e., 96.5% TD with the predicted densification rate. (auth)

25965 (WASH-1400(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. (USAEC, Washington, D. C.). Aug 1974. 244p. Dep. NTIS $7.60.

The risks to the public from potential accidents in nuclear power plants of the types being built in the United States are examined. Chapters are included on the meaning of risk, the nature of nuclear power plant accidents, risk assessment methodology, reactor accident risks, and comparison of risks. The technical work done in connection with the study is documented in detail in 12 appendices. The complete set of appendices may be purchased from National Technical Information Service, U. S. Dept. of Commerce, Springfield, Virginia in paper copy form for $174.50 or in microfiche for $20. (JWR)

25966 (WASH-1400(DR)(Summ.)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Summary Report. (USAEC, Washington, D. C.). Aug 1974. 32p. TIC Free.

25967 (WASH-1400(App. I)(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Appendix I. Accident Definition and Use of Event Trees. (USAEC, Washington, D. C.). Aug 1974. 229p. Dep. NTIS $14.50.

A description of event tree methodology and its role in defining complex accident sequences is presented. (JWR)

25968 (WASH-1400(App. II)(Vol. 1)(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Appendix II (Volume 1). Fault Tree Methodology. (USAEC, Washington, D. C.). Aug 1974. 173p. Dep. NTIS $11.75.

Methodologies used in constructing and quantitatively assessing fault trees are presented. (JWR)

25969 (WASH-1400(App.II)(Vol.2)(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Appendix II (Volume 2). PWR Fault Trees. (USAEC, Washington, D. C.). Aug 1974. 635p. Dep. NTIS $34.75.

25970 (WASH-1400(App.II)(Vol.3)(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Appendix II (Volume 3). BWR Fault Trees. (USAEC, Washington, D. C.). Aug 1974. 506p. Dep. NTIS $28.50.

25971 (WASH-1400(App. III)(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Appendix III. Failure Data. (USAEC, Washington, D. C.). Aug 1974. 219p. Dep. NTIS $14.00.

A compendium of data sources and data used in the quantitative evaluation of fault trees and event trees is presented. (JWR)

25972 (WASH-1400(App. IV)(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Appendix IV. Common Mode Failures. (USAEC, Washington, D. C.). Aug 1974. 99p. Dep. NTIS $8.00.

The techniques used to define contributions of common mode failures to overall risk assessment are summarized. (JWR)

25973 (WASH-1400(App. V)(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Appendix V. Quantitative Results of Accident Sequences. (USAEC, Washington, D. C.). Aug 1974. 170p. Dep. NTIS $11.50.

The probabilities of occurrence combined with radioactive releases are presented. The ordering of accident sequences to identify those sequences that are the major contributors to the various sizes of releases is included. (JWR)

25974 (WASH-1400(App. VI)(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Appendix VI. Calculation of Reactor Accident Consequences. (USAEC, Washington, D. C.). Aug 1974. 110p. Dep. NTIS $8.50.

The model for predicting the dispersion of radioactivity in the environment is presented, along with the models for predicting the effects in terms of fatalities, injuries, long term health effects, and property damage. (JWR)

25975 (WASH-1400(App. VII)(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Appendix VII. Release of Radioactivity in Reactor Accidents. (USAEC, Washington, D. C.). Aug 1974. 367p. Dep. NTIS $21.50.

The factors affecting the magnitude of the release of radioactivity from fuel under various conditions are examined, along with the transport and removal mechanisms that affect the release of radioactivity from the plant. (JWR)

25976 (WASH-1400(App. VIII)(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Appendix VIII. Physical Processes in Reactor Meltdown Accidents. (USAEC, Washington, D. C.). Aug 1974. 210p. Dep. NTIS $13.50.

The various engineered safety feature interactions as defined by accident sequences are described. Predictions of core and containment behavior are included, along with times of fuel melting, times and modes of containment failure, and the interactions of molten fuel and cladding with water and concrete. (JWR)

25977 (WASH-1400(App. IX)(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Appendix IX. Safety Design Rationale for Nuclear Power Plants. (USAEC, Washington, D. C.). Aug 1974. 86p. Dep. NTIS $7.50.

The safety design rationale currently used for BWR and PWR nuclear power plants is discussed. Included is a discussion of the barriers to the release of radioactivity and their design bases, as well as potential accident initiators, and features provided to mitigate the effects of accident initiators. (JWR)

25978 (WASH-1400(App. X)(Draft)) REACTOR SAFETY STUDY. An Assessment of Accident Risks in U. S. Commercial Nuclear Power Plants. Appendix X. Design Adequacy. (USAEC, Washington, D. C.). Aug 1974. 262p. Dep. NTIS $16.25.

The extent to which safety design requirements concerning seismic and accident environments have been fulfilled in the actual engineering design of the plants is discussed. (JWR)

25979 (WCAP-8342) WESTINGHOUSE EMERGENCY CORE COOLING SYSTEM EVALUATION MODEL: SENSITIVITY STUDIES. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Jul 1974. 172p.

A series of sensitivity studies were performed using codes which comprise the Westinghouse ECCS evaluation model. The studies, which were performed to establish code features, cover a wide range of parameters. For certain of the sensitivity studies, comparison with exact analyses was possible. This determined the value of the parameter employed with the evaluation model. For other parameters no comparison with an exact analysis is possible. In these cases, the effect of each parameter was separately determined. The final selection of the values to be used in the analysis was not simply based on the individual parameter's effect, but was more appropriately based on obtaining an overall conservative model. (auth)

25980 (WCAP-8356) WESTINGHOUSE EMERGENCY CORE COOLING SYSTEM: PLANT SENSITIVITY STUDIES. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Jul 1974. 425p.

Results of 2, 3, and 4 loop plant sensitivity studies using the Westinghouse Emergency Core Cooling System (ECCS) evaluation model are presented. These studies will be referenced by individual plant Safety Analysis Reports to aid in demonstrating compliance with the new ECCS Acceptance Criteria, 10CFR50.46. (auth)

25981 (WCAP-8373) QUALIFICATION OF WESTINGHOUSE SEISMIC TESTING PROCEDURE FOR ELECTRICAL EQUIPMENT TESTED PRIOR TO MAY 1974. Fischer, E. G.; Jarecki, S. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Aug 1974. 106p.

The theory and practice of single axis sine beat testing as it relates to the seismic qualification of electrical equipment is reviewed. Justification for the use of the single axis sine beat test, as implemented by Westinghouse, to seismically qualify equipment is provided, along with the Westinghouse position on the new requirements of the draft of revision 3 to the standard IEEE 344. Seismic qualification levels in terms of actual building floor motions are presented for all electrical equipment type tested prior to May 1974, using single axis sine beat tests. (auth)

25982 INITIAL VOIDING EXPERIMENTS WITH SODIUM UNDER LIQUID-METAL FAST BREEDER REACTOR CONDITIONS. France, D. M.; Carlson, R. D.; Rohde, R. R.; Charmoli, G. T. (Argonne National Lab., IL). Nucl. Sci. Eng.; 55: No. 1, 1-10(Sep 1974).

Sodium voiding during the initial time period subsequent to boiling inception was studied experimentally under forced convection with system parameters typical of liquid-metal fast breeder reactors. The annular flow area of the test section simulated a single reactor fuel element of 3-ft heated length. Transient void formations were measured along the test section length. Initial sodium-voiding characteristics were related to the maximum bulk superheat existing in the test section at the time of boiling inception. Significant differences in test section voiding were obtained under conditions of zero and high (100 to 160°F) superheats. Loop and pot-type reactor simulation conditions were employed. (auth)

25983 AGREEMENT ON REACTOR SAFETY WITH THE UNITED STATES. Wiss., Wirt., Polit.; 4: No. 11, 7-8(Mar 1974). (In German).

A discussion of the content of the agreement for intensifying the German-American cooperation in the field of reactor safety research, signed March 6, 1974 in Washington is presented. (GE)

25984 CONCRETE EXAMPLES OF REACTOR SAFETY. Developing Fuel Cycle One of the Main Topics. Lenz, W. VDI (Ver. Deut. Ing.) Nachr.; 28: No. 19, 4-5(May 1974). (In German).

From reactor meeting; Berlin, F. R. Germany (2 Apr 1974). 1 fig.

The 6th reactor conference, held from April 2-5, 1974 in Berlin, showed that the development and design of light-water reactors has now reached a state of maturity and that the topics to be discussed in this domain are the operating experience with this reactor type, improvements of individual components, and fuel cycle problems. The main subjects of this conference were the safety of nuclear power plants, risk evaluations, and the environmental impact. Other papers dealt with fuel and design problems associated with sodium and gas-cooled fast breeders and with the fusion reactors. (GE)

25985 SODIUM FIRES IN NUCLEAR POWER PLANTS. Menzenhauer, P. (Kernforschungszentrum Karlsruhe (F. R. Ger-

many). Inst. fuer Reaktorentwicklung). Brandschutz; 28: No. 2, 36-41(1974). (In German).

11 figs.

The behavior of liquid sodium in contact with air, especially with the process and development of sodium fires in technical plants, is discussed. (GE)

25986 ATOMIC ENERGY THREATENS MANKIND. OeTV-Magazin.; No. 5, 14-16(May 1974). (In German).

1 fig.

Critical comments upon the atomic energy program of the FRG for the period 1973 to 1976 are presented. (GE)

25987 HOW DANGEROUS ARE NUCLEAR POWER PLANTS? Bild Wiss.; 11: No. 3, 82-106(Mar 1974). (In German).

People from responsible G.F.R. ministries, science, industry, and citizens groups discuss the radiation exposure in the environment of a nuclear power plant, the risks from living near a reactor station, and the threat of a radioactivity accident. (GE)

25988 INSURANCE OF TWO POWER PLANTS AT THE SAME SITE. Feldmann, J. (Allianz Versicherungs-A.G., Muenchen (F. R. Germany). Abt. Technische Versicherungen); Bremkamp, D. (Allianz Versicherungs-A.G., Muenchen (F. R. Germany). Feuerabteilung); Kuhn, O. (Allianz Versicherungs-A.G., Muenchen (F. R. Germany). Abt. Haftpflicht). Atomwirt., Atomtech.; 19: No. 7, 351-356(Jul 1974). (In German).

From 7th technical Allianz colloquium; Muenchen, F. R. Germany (4 Dec 1973). 5 figs.

The erection of two nuclear power plants at the same site leads to a great concentration of value and therefore a considerable increase of insurance value and by that to an increase of the required insurance capacity. By example of three different systems—the mono unit, the double unit and the twin unit—it is shown which insurance possibilities exist and how the maximum probable loss can be reduced by dividing into different complex branches. A special problem is the nuclear liability insurance, because reciprocal liability claims of both reactors may result in a diminution of a third-victim-protection. In any case a common insurance cover would be favorable. (auth)

25989 PYROCARBON AND ITS APPLICATION TO REACTOR TECHNOLOGY. Nickel, H. (Kernforschungsanlage Jülich GmbH, Institut für Reaktorwerkstoffe, Jülich, West Germany). J. Vac. Sci. Technol. 11: No. 4, 687-694 (July 1974).

A survey of deposition methods for pyrocarbons is given, especially of the fluidized bed process for nuclear fuel kernel coating. In the fluidized bed process, it is possible to deposit isotropic pyrocarbon layers which are much more resistant to fast neutron irradiation than are anisotropic pyrocarbon layers. It has been demonstrated that the previous evaluation techniques are not sufficient to characterize isotropic pyrocarbon material. Therefore increased efforts have been made to develop new methods which are described and discussed. Also results of irradiation behavior of pyrocarbon fuel particles coatings are mentioned. (auth)

25990 HUMAN AND ECOLOGIC EFFECTS OF NUCLEAR POWER PLANTS. Sagan, L. A. (ed.). Springfield, IL; Charles C Thomas, Publisher (1974). 552p. $34.50.

Separate abstracts are included for each of the 14 chapters presented concerning the generation and management of radioactivity and ecologic effects of nuclear power generation. (DCC)

For abstracts of individual chapters see: 23729, 23752, 23978, 23979, 24029, 24366, 24372, 24389, 24822, 25822, 25823, 25886, 25991, and 25992.

25991 POWER REACTOR SITING. A Summary of United States Practice. Gifford, F. A. (Atmospheric Turbulence and Diffusion Lab., Oak Ridge, TN). pp 46-71 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (Ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

Procedures followed and regulations controlling the siting of nuclear power plants in the U. S. are reviewed. (DCC)

25992 ACCIDENTAL RELEASES. Otway, H. J. (Los Alamos Scientific Lab., NM). pp 132-150 of Human and Ecologic Effects of Nuclear Power Plants. Sagan, L. A. (Ed.). Springfield, IL; Charles C Thomas, Publisher (1974).

Radiation hazards associated with nuclear power plant accidents are analyzed. The types of major accidents possible in power reactors and the engineered safeguards used to suppress radiation hazards from these accidents are described. Risks to the public from reactor accidents are discussed. (DCC)

25993 ON THE DIFFERENCE OF THE ISOTOPIC COMPOSITION OF RELEASED FISSION GASES BETWEEN INTACT AND DEFECT FUEL ELEMENTS. Fleck, C. M.; Fritsch, W.; Erber, H. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Atomkernenergie; 23: No. 3, 203-207(1974).

5 figs.; 1 tab.; 27 refs.

The isotopic composition of fission gas released from fuel elements of the TRIGA Mark II reactor after shut down has been analyzed. It could be shown that for most of the elements, the U-contamination of the cladding surface was responsible for the isotopic ratios measured. Only two of the elements showed a highly significant difference in the isotopic composition of the released rare gases. With release parameters measured elsewhere, the change in the isotopic composition and the leak size could be calculated within an acceptable error. Related to the fission gas inside the plenum, release rates of 4.28×10^{-7} s^{-1} and 1.9×10^{-6} s^{-1} could be obtained for these leaks. (auth)

25994 COMPARISON OF MODELS FOR ANALYSIS OF BLOWDOWN TESTS. Shimizu, S. (Electrotechnical Lab., Tokyo). Nippon Genshiryoku Gakkaishi; 16: No. 3, 148-156(Mar 1974). (In Japanese).

A blowdown test facility was established in 1965 to obtain information on the blowdown phenomena associated with a loss-of-coolant accident in water-cooled power reactors. Parametric blowdown tests were performed to evaluate the influence of rupture size, rupture location, initial coolant temperature and system pressure on the rate of change of void fraction in the system following the accident. Results obtained from experiments on ruptures occurring in the steam line and in the recirculation line are analyzed. A discussion is given on the validity of the proposed models, making use of the BABLO code developed by the author and of the RELAP-2 code by the USAEC. The major results obtained are: (1) for the case of the steam-line rupture, substantiation of the validity of the homogeneous model for evaluation of the discharge flow when the mixture level is assumed not to be related to the location of the rupture in the BABLO code, and (2) for the case of the recirculation line rupture, proof of the validity of the bubble separation model used in the RELAP-2 code for evaluation of the discharge flow. (auth)

25995 MOLTEN-SODIUM INTERACTION ON LMFBR SAFETY. Mizuta, H. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Nippon Genshiryoku Gakkaishi; 16: No. 5, 241-246(May 1974). (In Japanese).

The most important safety problem concerning the LMFBR is related to core component damage caused by molten fuel coolant interaction. This problem has been reviewed under the items of out-of-pile test, in-pile test and analytical models. The elements of the physical geometry relevant to the out-of-pile test are shocktube, tank, jet injection, mixing and fuel pin. The major difficulty is to melt the large amount required of fuel (10 kg). The in-pile test facilities operative today are TREAT, ETR, CABRI and HFR. Almost all the analytical models are based on the Cho-Wright model. (auth)

25996 SAFETY OF NUCLEAR POWER GENERATION. Togo, Y. (Tokyo Univ.). Karyoku Genshiryoku Hatsuden; 24: No. 5, 545-552(May 1973). (In Japanese).

Features of the safety of nuclear power generation are reviewed with discussions of: the concept of safety; systems for securing safety in nuclear power generation; safety design; safety evaluation; and environmental problems. The safety of nuclear power generation is a compromise between the benefits and risks to humans. In considering the safety of nuclear power generation, the overall system is first conceived, and the studies of its respective components follow. While the safety evaluation is classified as to safety in normal operation and during or following accidents, accidents include both accidents of reactivity and loss of coolant. The environmental problems of nuclear power plants include those related to the release of warm water and inherent radioactivity and, in the long run, global contamination. (JA)

25997 TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY CONFERENCE ON NUCLEAR POWER PLANT SITING, PORTLAND, OREGON, AUGUST 25–28, 1974. Farmakes, R. (ed.). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 1-53(1974).

Summaries of the thirty five papers presented at the August 1974 Conference on Nuclear Power Plant Siting are included. Each paper has been title listed and indexed separately for NSA. (DG)

For abstracts of individual papers see: 25998–26007, 26051–26067, and 26092–26099.

25998 RATIONALE OF REACTOR SITE SELECTION FOR PUBLIC SAFETY. Beattie, J. R. (United Kingdom Atomic Energy Authority, Warrington, Eng.). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 15-16(1974).

From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

25999 TECHNIQUE FOR CONSIDERATION OF POPULATION IN SITE COMPARISON. Kohler, J.; Kenneke, A.; Grimes, B. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 16-19(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26000 SITING CONSIDERATIONS FOR RADIOACTIVITY IN REACTOR EFFLUENTS DURING NORMAL OPERATION. Graf, J. M.; Strom, P. O. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 19-21(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26001 ASSESSMENT OF THE RADIOLOGICAL ENVIRONMENTAL IMPACT OF NUCLEAR REACTORS. Parsont, M. A.; Kastner, J. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 21-22(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26002 SAFETY EVALUATIONS OF THE HTGR AS RELATED TO 10CFR100 SITING REQUIREMENTS. Moffette, T. R. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 22-24(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26003 SENSITIVITY OF DIFFUSION ESTIMATES TO METEOROLOGICAL DATA RECOVERY AND ACCURACY. Woodard, K. (Pickard, Lowe, and Associates, Inc., Washington, DC). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 24-26(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26004 THERMAL DISCHARGE FROM POWER GENERATION AT INLAND AND COASTAL SITES. Miner, R. M. (Pacific Gas and Electric Co., San Ramon, CA). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 27-28(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26005 HAZARDS TO NUCLEAR PLANTS FROM SURFACE TRAFFIC ACCIDENTS. Hornyik, K. (Oregon State Univ., Corvallis). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 33-34 (1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26006 METHOD FOR COMBINING SOCIETAL AND TECHNICAL JUDGMENTS IN ENVIRONMENTAL DECISION MAKING. Burnham, J. B. (Battelle-Northwest Labs., Richland, WA); Nealey, S. M.; Maynard, W. S. Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 48-49(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26007 METHOD FOR THE QUANTIFICATION OF AESTHETIC VALUES FOR ENVIRONMENTAL DECISION MAKING. Jones, G. R. (Jones and Jones Landscape Architects, Seattle, WA); Gray, B. A.; Burnham, J. B. Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 49-50(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

Reactor Theory and Calculation

Refer also to abstracts 25514, 25582, 25896, 25897, 25904, and 25947.

26008 (AE-487) STUDIES OF TURBULENT FLOW PARALLEL TO A ROD BUNDLE OF TRIANGULAR ARRAY. Kjellstroem, B. (Aktiebolaget Atomenergi, Studsvik (Sweden)). May 1974. 188p. Dep. NTIS (US Sales Only) $12.50.
Results are presented from an experimental study of turbulent flow of air in a rod bundle of triangular array with a pitch to diameter ratio of 1.22. A Reynolds number range from 150,000 to 370,000 was covered. The experiments included measurements of pressure drop and local distributions of the wall shear stress, the axial and secondary flow velocities, turbulence intensities, and Reynolds stresses. The results for the friction factor of inner subchannels of the bundle show on the average 5.7% higher values than predicted for smooth tubes. This is an excellent agreement with predictions by the method suggested by Rehme (1973). The dimensionless distributions of the axial velocity u^+ (y^+) are in reasonable agreement with both the conventional law-of-the-wall and the dimensionless velocity distribution suggested by Eifler (1968). The secondary flow velocities measured show great scatter. The presence of secondary flow loops inside unit cells, with velocities less than 1% of the average axial velocity, is however indicated by the measurements. The results of the turbulence measurements show reasonable agreement with earlier reported data for flow in tubes. The average lateral eddy diffusivity of axial momentum in the gap region, calculated from the experimental data, shows excellent agreement with predictions by the method suggested by Kattchee and Reynolds (1962). The momentum mixing factor could be estimated to be about 2.0, which is a factor of four lower than predicted by the method suggested by Ingesson (1970). In an actual fuel element the momentum and heat exchange between subchannels will be enhanced by secondary flows, caused for instance by geometrical imperfections. It is recommended that the upper limit for the total exchange due to turbulence and such secondary flows is estimated with the model of Ingesson (1970). A lower limit for the exchange can be estimated as 25% of the value predicted with this model. (auth)

26009 (CEA-N-1708) NUCLEAR REACTOR SUB-CRITICAL SOURCE AND REACTIVITY IDENTIFICATION BY THE MODELLING METHOD. Tapu, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). Nov. 1973. 22p. (In French). (SES-PUB-SAI-73-237). Dep. NTIS (US Sales Only) $4.25.
An identification method is described which makes it possible to calculate the nuclear reactor subcritical reactivity when the source is not well known. This method has been used successfully for reactivity measurements by using neutron flux measurement equipment with a minicomputer. (FR)

26010 (CONF-740903-3) FAST REACTOR PROCESSING CODES: IS THERE A DOLLARS WORTH OF DIFFERENCE BETWEEN THEM? Weisbin, C.; Greene, N. M.; Henryson, H. II; LaBauve, R. J.; Durston, C.; Cullen, D. E.; Kidman, R. B. (Oak Ridge National Lab., Tenn. (USA)). 1974. 6p. Dep. NTIS $4.00.
From meeting on advanced reactors; physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).
The range of applicability and the effort required in processing ENDF/B cross sections with several multigroup averaging programs are discussed to demonstrate the significant differences between the algorithms employed and the variation in the versatility of several of the codes. Emphasis is placed on approximations used, areas of validity, computing time required, and existing experience. (DG)

26011 (DP-1352) COMPARISON OF PULSED NEUTRON EXPERIMENTS AND DIFFUSION THEORY SPACE-TIME CALCULATIONS. Parks, P. B.; Stewart, J. W. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jun 1974. Contract AT(07-2)-1. 32p. Dep. NTIS $4.00.
Direct space-time diffusion theory codes in two and three dimensions were applied to the problem of calculating the pulsed neutron experiment. Comparisons of two-group calculations and experiments on bare and reflected thermal reactors showed that, after suitable normalization of the production cross sections ($\nu\Sigma_f$), the overall prompt neutron response to a pulsed source was well represented by the codes. The source-induced harmonic response during and just after the source burst was less well represented with several approximate treatments for describing the neutron source. The ability to calculate the pulsed neutron experiment led to a new method of deriving subcritical reactivity from the measured data. This "space-time" method of analysis uses the normalized cross sections, found in fitting the source response calculation to the experimental data, in a static calculation of the reactivity. The derived reactivity from the space-time method is unaffected by the problems of kinetic distortion and prompt and delayed harmonics; hence, its use removes the necessity for deriving correction factors for these effects. Small errors in the neutron lifetime (through input velocities and absorption cross sections) may still be present; however, the variation of lifetime with subcritical reactivity is expressly included in the treatment. (auth)

26012 (DP-MS-74-31) RECENT DEVELOPMENTS IN THE RESPONSE MATRIX METHOD. Pryor, R. J. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). [nd]. Contract AT(07-2)-1. 14p. (CONF-740903-1). Dep. NTIS $4.00.
From meeting on advanced reactors; physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).
Recent developments in the response matrix method are discussed. Particular attention is given to the derivation of the static response matrix, and two alternative approaches to the time-dependent problem are considered. Solution methods and future developments are also discussed. 10 references. (auth)

26013 (IAEA-R-706-F) CROSS-FLOW AND MIXING BETWEEN SEMI-OPEN CHANNELS IN NUCLEAR REACTORS. Final Report, 1 January 1969–28 February 1973. Hetsroni, G. (International Atomic Energy Agency, Vienna (Austria)). Oct 1973. vp. INIS.

The objective of the research was to advance the state of the knowledge regarding turbulent mixing in rod bundle flow. To this end, two lines of research were pursued: (a) Development of a Monte-Carlo type numerical method of calculation of thermal diffusion in turbulent channel flow; and (b) Measurement of detailed characteristics of turbulent flow in rod-bundle channels. The main conclusion is that a Monte Carlo method can be successfully applied to a problem of turbulent diffusion in a complex geometry. The Monte Carlo program would be preferable for large grid sizes, in which its advantage is that (a) the program itself requires less core memory, and (b) the program operates basically in integer mode, and therefore is not subject to error accumulation, which becomes prohibitive for a conventional program with large sizes. In the experimental part, detailed maps of velocity and turbulence were obtained, which can serve as input data for further calculations. (INIS)

26014 (KFKI-74-22) COBRA-2/KFKI, A DIGITAL COMPUTER PROGRAM FOR THERMAL–HYDRAULIC SUBCHANNEL ANALYSIS OF ROD BUNDLE NUCLEAR FUEL ELEMENTS. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 25p. Dep. NTIS (U. S. Sales Only) $4.25.

COBRA-2/KFKI is a digital computer program for ICL-1905 computer in FORTRAN language. The program is a modified and steady-state version of the original COBRA-3 code. The code calculates the steady-state flow and enthalpy transport in rod-bundle nuclear fuel elements in both boiling and nonboiling conditions. The mathematical model is formulated by dividing the bundle flow area into flow subchannels that are assumed to contain one-dimensional flow and are coupled to each other by turbulent and diversion crossflow mixing. A semiexplicit finite-difference scheme is used to perform a boundary-value solution where the boundary conditions are the inlet enthalpy, inlet flow rate, and exit pressure. (auth)

26015 (ZfK-259) SPACE DEPENDENT EFFECTS ACCORDING TO ROD DROP EXPERIMENTS. Barz, H. U. (Deutsche Akademie der Wissenschaften zu Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jul 1973. 18p. (In German). Dep. NTIS (US Sales Only) $4.00.

It is shown that the space-dependent effects arising in reactivity measurements by the rod drop method can be corrected by general considerations provided that the measured flux values after the prompt decay are taken into account. For the case where the dropping time is not negligible two additional fitting constants are needed. Especially for high reactivities it appears to be reasonable to take into account the prompt contribution. For this part an expression can be obtained, in which the fitting constants of the delayed part are included also. (auth)

26016 MEASUREMENT OF ANISOTROPIC NEUTRON DIFFUSION COEFFICIENTS IN SQUARE LATTICES OF ALUMINUM IN LIGHT WATER BY THE PULSED NEUTRON METHOD. Kaneko, Y.; Akino, F.; Suzuoki, Y.; Kitadate, K.; Kurokawa, R.; Koyama, K. (Japan Atomic Energy Research Inst., Tokai). Nucl. Sci. Eng.; 55: No. 1, 105-116(Sep 1974).

Neutron diffusion coefficients were measured in square lattices of aluminum channels in light water in both the axial and the radial directions by the pulsed neutron technique. The diameter of the channels was 15 mm and the pitch of the lattice was 19 or 24 mm. Good agreement was observed between the experimental values of the axial diffusion coefficient, D_z, and those calculated by the two-dimensional discrete S_n method. In this calculation, the value of the diffusion coefficient was interpreted as the slope of the decay constant as a function of the geometrical buckling in the axial direction of the channels. Also, the measured values of the radial diffusion coefficients agreed well with those calculated by the well-known Benoist practical formulas. The relation between the extrapolation distance and the effective transport length in the axial direction, l_z and $3D_z/V$ was numerically investigated. The ratio of the former to the latter is found to be considerably higher than the value of 0.71 used hitherto. (auth)

26017 COMPARATIVE ANALYSIS OF NEUTRON DATA FILES AS A SENSITIVITY STUDY. Segev, M.; Yiftah, S.; Gur, Y.; Gitter, L. (Israel Atomic Energy Commission, Yavne). Nucl. Sci. Eng.; 55: No. 1, 103-104(Sep 1974).

Perturbation analysis of cross-section differences between the ENDF/B-III file and the KEDAK file helped identify those differences to which k_{eff} of large fast systems was sensitive. The interpretation of differences between independently evaluated files as inherent inaccuracies in current experimental data led to recommended requirements for experimental accuracy in ^{239}Pu and ^{238}U fission and capture cross sections. (auth)

26018 ACCELERATED SPECTRAL SYNTHESIS TECHNIQUE. Price, W. G. Jr. (Princeton Univ., NJ); Ouderstadt, J. J. Nucl. Sci. Eng.; 55: No. 1, 98-103(Sep 1974).

Spectral synthesis, the representation of the energy dependence of the neutron flux by a combination of overlapping trial modes, has received only limited application to the analysis of fast reactors, because the savings in computational effort achieved via synthesis have not been sufficiently dramatic to compensate for the occasional disconcerting failures of the methods. An approximation procedure combining spectral synthesis with Wielandt's method which recovers the large savings in computation time expected with synthesis methods is presented. Such a scheme is illustrated by applying it to calculate the flux in a fast critical assembly. (auth)

26019 EVALUATION OF INTEGRALS BY DIFFERENTIATION WITH APPLICATION TO COLLISION METHODS. Bitelli, G.; Turrin, A. (Comitato Nazionale per l'Energia Nucleare, Rome). Nucl. Sci. Eng.; 55: No. 1, 96-97(Sep 1974).

The main difficulty which arises in the use of collision methods consists in integrating over functions having a pole at some point. This fact implies the need for very careful and extensive numerical calculations to obtain good results. An integration method, which also has general validity, is presented to overcome such a difficulty. It is shown that this method can be applied in collision problems connected with the physics of nuclear reactors. (auth)

26020 NEW CRITERION OF THE ASYMPTOTIC STABILITY OF REACTOR WITH TEMPERATURE-XENON FEEDBACK. Podowski, M. (Politechnika Warszawska (Poland). Instytut Techniki Cieplne). Atomkernenergie; 23: No. 3, 181-184(1974).

7 refs.

The new method of analysis of the asymptotic stability in the large (A. S. L.) for point reactor with temperature- and xenon non-linear feedback is investigated. This method is based on the application of functional analysis. The condition of A. S. L. is obtained. The results are more general than others, which are based on the Liapunov second method. (auth)

26021 SOME COMMENTS ON THE STATISTICAL BEHAVIOUR OF NUCLEAR REACTORS AT CRITICALITY. Williams, M. M. R. (London Univ. (UK). Dept. of Nuclear Engineering). Atomkernenergie; 23: No. 3, 177-180(1974).

5 refs.

The divergence of the auto correlation function, power spectral density, and variance to mean ratio at criticality is discussed for a zero power system. Using point model kinetics, it is shown that either operator control or temperature feedback can be invoked to explain the absence of such phenomena in practical reactor systems. The Langevin technique is used with a white noise equivalent source to simulate the fission process. (auth)

26022 ON THE INTERPRETATION OF MARKOV PROCESSES IN A NUCLEAR REACTOR. Lewins, J. (Hughes Parry Hall, London (UK)). Atomkernenergie; 23: No. 3, 172-176(1974).

1 fig.; 4 tabs.; 15 refs.

An exact solution of the binary fission model is used to obtain expressions for the variance-to-mean ratio of neutrons in such a model. The results are compared with the conventional formulas to interpret Markov processes in a reactor (especially the Rossi-alpha and Feynman variance experiments) to illuminate the significance to be placed upon the behavior of these formulas as the reactor approaches criticality. A suggested modification of the results is indicated. (auth)

26023 PROMPT NEUTRON BEHAVIOUR AND THE POINT REACTOR MODEL IN SMALL CRITICAL AND SUB-CRITICAL FAST ASSEMBLIES. Paynter, R. J. (Imperial Coll. of Science and Tech., London); Besant, C. B.; McTaggart, M. H. Ann. Nucl. Sci. Eng.; 1: No. 4, 265-275(Apr 1974).

According to a point reactor model of nuclear kinetics the prompt neutron density in a sub-critical fissile assembly decays exponentially with a time constant, usually termed α, which is linearly related to the reactivity by a constant prompt neutron generation time. This linear relationship between α and reactivity extrapolates to prompt critical at $\alpha = 0$. Departures from this model have been reported by several observers. In assemblies driven by a pulsed neutron source, even when initial transients have been allowed to die away the prompt decay is not always found to be exponential and extrapolation of the relation-

ship between assigned decay constants and reactivity does not always yield prompt critical at $\alpha = 0$. Precise measurements of prompt decay for some VERA assemblies demonstrate the limited range of validity of the point reactor model. The measurements are compared with SWANTIME calculations. This time-dependent code is a multi-group multi-region diffusion theory version of the prompt kinetic equations. Though this treatment is not designed to analyse the decay in simple terms such as a sum of exponential decays, it does show that a softening of the spectrum occurs as the population decays. For this softer spectrum the decay exponent is smaller than for the corresponding steady state calculation and is no longer proportional to reactivity and so cannot be used directly as a measure of the reactivity of a subcritical reactor. Reactivities based on the ratio of prompt to delayed contributions to the measured decay agree with those based on conventional period measurements used to calibrate control rods. If a linear relationship is assumed between alpha and reactivity, errors in estimating subcritical reactivities can be as large as 20%. To some extent this also provides a check that the delayed neutron data, in terms of relative abundances and decay constants, are adequate for both ^{235}U and ^{239}Pu. (auth)

Reactor Components and Accessories

Refer also to abstracts 24594 and 24596.

26024 (ORNL-TM-4478) COMPARISON OF THEORETICAL AND EXPERIMENTAL STRESSES ON SPHERICAL SHELLS HAVING SINGLE RADIAL AND NONRADIAL NOZZLE ATTACHMENTS. Gwaltney, R. C.; Greenstreet, W. L. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 34p. Dep. NTIS $4.00.

Radial and nonradial nozzles attached to spherical shells are analyzed and comparisons made between stress distributions for two radial and one nonradial nozzle geometry. The calculated results are compared with experimental results obtained from extensively strain-gaged machined steel models which were tested to provide data for direct use in analytical method development and assessment. The nonradial nozzle was attached at an angle of 22.5° from the normal, and all nozzles protruded into the vessels. The spherical shells have the same dimensions; one of the radial nozzles is the same size as the nonradial nozzle, while the other is larger in diameter and thickness. Loading results are compared for axial forces and pure bending moments applied to the nozzles and for internal pressure loadings. Agreement between calculated and measured results is good, except in a few instances, and the maximum stress in each case is predicted with reasonable accuracy. Stress distributions for the nonradial and the radial nozzle attachments are quite similar. Comparisons between the nonradial nozzle and the smaller radial nozzle showed that the higher stresses, both theoretical and experimental, occurred in the nonradial nozzle for all loading cases. (auth)

26025 (RT/ING-(74)11) THERMOHYDRAULIC LOOPS OF REACTOR TECHNOLOGY LABORATORY. Cumo, M.; Farello, G. E.; Palmieri, A.; Pitimada, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Div. Affari Internazionali Studi Economici). Feb 1974. 56p. (In Italian). Dep. NTIS (US Sales Only) $6.00.

A schematic description of the experimental loops for the thermohydraulic tests available at the CNEN reactor technology laboratory is presented. The experimental set ups are devoted to the testing of nuclear reactor components such as fuel elements, steam generators, heat exchangers, etc. The loops may be subdivided in adiabatic and diabatic plants following the heat transfer in the test sections. Adiabatic loops are designed at atmospheric temperature to measure pressure drops, velocity distributions and induced vibrations and at high temperature and pressure mainly to study corrosion fretting phenomena. Diabatic loops are designed to study the heat transfer in single and two phase flows. Typical test section conditions include imposed heat fluxes (by Joule effect) and imposed temperature drops (heating with another fluid). These loops enable a full set of tests both of basic and fundamental character on heat transfer mechanisms and direct tests on actual reactor conditions for which the full scale reproduction is necessary. (auth)

26026 CALCULATIONS OF A FAST-NEUTRON SHIELDING EXPERIMENT FOR EVALUATING APPROXIMATE SHIELDING DESIGN METHODS. Adkins, C. R. (Carnegie-Mellon Univ., Pittsburgh). Nucl. Sci. Eng.; 55: No. 1, 89-116(Sep 1974).

A fast-neutron shielding experiment performed by Atomics International is analyzed using modified ENDF/B-II data in Russian format, space-dependent elastic removal corrections, and one-dimensional discrete ordinates calculations. The scattering cross sections are transport corrected P_0. The analysis of this particular experiment showed: the data used for sodium, iron, chromium, and nickel are reasonably good for predicting the space-dependent spectra and flux attenuation within the uncertainties of the approximate methods used; the void streaming correction of Olsen is quite accurate and necessary for this experiment, due to streaming at dosimetry gaps; the treatment of higher order anisotropy in the neutron scattering does not appear to be very important in this analysis; and the need for a two-dimensional calculation to better predict flux attenuation, accounting for the spatial variation of the transverse flux distribution (buckling reduction with depth of penetration). (auth)

26027 BOILER DYNAMICS AND CONTROL IN NUCLEAR POWER STATIONS. Proceedings of International Conference Held in London, England, March 22–23, 1973. London; British Nuclear Energy Society (1973). vp.

The proceedings of a conference concerned with the influence of power system requirements on the design and control of nuclear boilers are presented. The constraints which limit performance and the strategies adopted to optimize the dynamic response of various boiler systems were of particular interest. The proceedings comprise nineteen papers, for which separate abstracts are presented, and include the discussions and the opening and closing addresses. (UK)

For abstracts of individual papers see: 25821, 25832, 25833, 25846–25853, 25883, 25884, 26028–26031, 26043, and 26044.

26028 REQUIREMENTS FOR NUCLEAR BOILERS, THEIR OPERATING CONSTRAINTS, AND DYNAMIC PERFORMANCE. Butterfield, M. H. (Atomic Energy Establishment, Winfrith, Eng.); Tasker, R. V.; Whitmarsh-Everiss, M. J. pp Paper No. 1 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

A nuclear plant installed to supply electricity into a system must operate to satisfy the flexibility requirements of that system, and assist its dynamic performance. Known forms of system load history and generating plant mix imply particular dynamic forcing functions at the plant boundary and, depending on the control system design, particular variations within the boiler itself. These interact with the boiler material constraints in a way which potentially may reduce the life of the plant. These topics are discussed by considering the UK grid system requirements, dynamic performance, and constraints met in some current boiler designs. (auth)

26029 DYNAMIC MODEL VERIFICATION BY COMPARISON WITH PLANT TESTS ON WINFRITH SGHWR. Butterfield, M. H.; Gall, C. J. (Atomic Energy Establishment, Winfrith, Eng.). pp Paper No. 3 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

The need to establish a scientifically based method of assessing mathematical models used for control system design is discussed. An approach is described which compares transient responses recorded from plant tests with corresponding model transients. Parameters in the model are then adjusted to minimize an error criterion which is formed from a time-weighted squared error integral. The form of the time-weighting is chosen from frequency response considerations. An example, based on transients recorded on the Winfrith SGHWR plant and simulator model, is used to illustrate the method, and a significant improvement to the model has resulted. (auth)

26030 REVIEW OF TWO PHASE FLOW INSTABILITY ASPECTS OF BOILER DYNAMICS. Potter, R. (Atomic Energy Establishment, Winfrith, Eng.). pp Paper No. 13 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

The current state of the subject of two phase flow instability is reviewed, and the types of instability and the resulting problems are indicated. The absence of published data has made it necessary to present a personal view of the design and operational

importance of the subject. Use of "gags" to improve stability is discussed and adverse circuit features noted. Differences resulting from water, sodium or gas as the primary fluid are referred to and also the differences between recirculating and once-through designs. Methods of examining stability behavior are considered and the ability of available theoretical methods to predict this behavior is discussed. (auth)

26031 EXPERIMENTAL AND ANALYTICAL MODELLING IN BOILER DESIGN. Ruffell, A. E.; Newnham, R. A.; Worley, N. G. (Babcock and Wilcox Ltd., London). pp Paper No. 16 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

Present day requirements for detailed and precise prediction of nuclear boiler performance are reviewed and shown to require basic research and validation by study of model boilers. The role of experimental and analytical modelling in boiler design together with the specification of rigs is discussed. (auth)

26032 PIPING DESIGN IN THE CONSTRUCTION OF NUCLEAR POWER PLANTS. Kani, J.; Nakayama, S.; Yamamoto, Y. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Haikan Gijutsu; 15: No. 13, 69-79(Sep 1973). (In Japanese).

Differing from the case of fossil-fuel power plants, the safety requirements for nuclear power plants including piping are stringent due to radiation hazards involved. The guidelines for the design of piping are based on the U. S. AEC's general design criteria for nuclear power plants. In stress analysis, the piping is grouped into three grades according to safety requirements. In this connection, the provisions of ASME Section III are applied. The piping in nuclear power plants is also classified by aseismic consideration. In design, in-service inspection accessibility of the pipings must also be considered. (JA)

26033 BUS DUCT CONDUCTORS BETWEEN GENERATOR AND TRANSFORMER IN LARGE THERMAL AND NUCLEAR GENERATING STATIONS. Nisol, R. (Societe Simel, France). Polytech. Tijdschr., Elektrotech./Electron.; 29: No. 9, 273-277 (1 May 1974). (In Dutch).

An exposition is given of the case for forced cooling of the main conductors in large thermal and nuclear generating stations, carrying currents of up to 33,000 A. Drawings are given of the means employed. (NL)

Reactor Fuels

Refer also to abstracts 23567, 23737, 23741, 23743, 23745, 23748–23750, 23752, 24013, 24120, 24477, 24479, 24511, 24566, 24606, 24627, and 25989.

26034 (RT/ING-(74)13) EXPERIMENTAL STUDY ON THE THERMAL BEHAVIOUR OF FUEL RODS. Conductivity Integral of Vipac Fuel Rods Bearing UO_2 Powder and UO_2-PuO_2 Sol-Gel Spherepac. Calza-Bini, A.; Cosoli, G.; Filacchioni, G.; Lanchi, M.; Nobili, A.; Rocca, U. V.; Rotoloni, P. L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Div. Affari Internazionali e Studi Economici). Apr 1974. 71p. (In Italian). Dep. NTIS (US Sales Only) $6.75.

The results of irradiation experiments carried out in the Siloe reactor at Grenoble on fuel rods bearing UO_2 powder and UO_2-PuO_2 sol-gel spherepac are presented. The measured values of conductivity integral and fuel-clad gap conductance are reported. (auth)

26035 (UCID-15469) NEUTRONIC AND THERMAL ANALYSIS OF THE BMI LRL UN IRRADIATION CAPSULE NO. 1. Lee, J. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Jan 1968. 39p. Dep. NTIS $5.00.

An independent neutronic and thermal analysis of BMI's LRL UN irradiation capsule #1 was performed to both test the methods employed and to reduce uncertainties in the UN specimens test fission rate and temperatures. (auth)

Reactor Control Systems

26036 (GA-A-12945) TWO-LOOP CONTROL SYSTEM MODEL/SIMULATION OF THE HIGH-TEMPERATURE GAS-COOLED REACTOR (HTGR) PLANT FOR THE FORT ST. VRAIN NUCLEAR GENERATING STATION. Netzel, L. J. (General Atomic Co., San Diego, Calif. (USA)). 15 Apr 1974. Contract AT(04-3)-633. 13p. (CONF-740461-1). Dep. NTIS $4.00.

From fifth conference on modeling and simulation; Pittsburgh, Pennsylvania, USA (24 Apr 1974).

The development of a simplified mathematical model and analog/hybrid computer simulation of the Fort St. Vrain HTGR is discussed. The equations used to model the plant and equipment transfer functions are presented. The overall plant control system design is discussed in the time and frequency domains. Some possible improvements in plant control are evaluated. (auth)

26037 (GA-A-12947) INSTALLATION AND PREOPERATIONAL EXPERIENCE WITH HTGR CONTROL ROD DRIVES. Rosenberg, R. (General Atomic Co., San Diego, Calif. (USA)). 25 Mar 1974. Contract AT(04-3)-633. 34p. (CONF-740918-3). Dep. NTIS $4.75.

From joint power generation conference; Miami Beach, Florida, USA (15 Sep 1974).

The Fort St. Vrain High-Temperature Gas-Cooled Reactor (HTGR) is the first commercial HTGR to control reactivity of the core with cable-actuated control rods driven by an electrically powered winch system. The basic design of the control rod drive and the research and development program that produced it are described. During the field installation and checkout of this equipment, several problems occurred and field modifications were made to correct them. These problems, their solutions, and their influences on follow-on designs are discussed. It was concluded that this control rod drive design is capable of a problem-free operational life. (auth)

26038 (GA-A-12990) GAS TURBINE HTGR POWER PLANT CONTROL AND SAFETY STUDIES. Quarterly Progress Report, January 1, 1974–March 31, 1974. (General Atomic Co., San Diego, Calif. (USA)). 22 May 1974. Contract AT(04-3)-167. 100p. Dep. NTIS $5.45.

Work performed for the period January 1, 1974 to March 31, 1974 covers the design and analysis of the control system for the Gas Turbine High-Temperature Gas-Cooled Reactor (HTGR) power plant and the analysis of safety questions on the plant. The steady-state performance of the Gas Turbine HTGR using antifreeze in the precooler cooling system for cold weather operation was analyzed. Investigation of a vortex valve which aids in the bypass control mode of operation was initiated. Transient analysis was performed to analyze load-changing capability by (1) rapid changes in precooler water flow and temperature and (2) rapid introduction of inventory. The safety analysis tasks performed during this quarter included assignment of safety classes for major components, bounding calculations for certain internal pressure boundary ruptures, and preliminary analysis of turbomachine failures, precooler failures, and containment response to a PCRV depressurization accident. (auth)

26039 (GEAP-13771-10) NUCLEAR DESIGN AND SHIELDING. Tenth Quarterly Report, January–March 1974. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Apr 1974. Contract AT(04-3)-893. 102p. AT.

Current activities and technical progress for the period January through March 1974 are reported for four subtasks. Subtask A covers the post-analysis of the Demonstration Plant Benchmark Critical Experiments in ZPPR-3 and the technical direction and analysis of similar experiments in ZPPR-4. Subtask B is directed toward the development of the calculational methods that can be used at the sites of the Demonstration and later LMFBR Plants to determine the reactor power distribution, reactivity and fuel status, and for consideration of alternate fuel and control management schemes. Subtask C is in support of the nuclear data evaluation and testing efforts and methods development for the national LMFBR program. Subtask D progress is reported for the pre-measurement analysis of selected LMFBR shielding experiments. These experiments will be completed at ORNL's Tower Shielding Facility during FY-75. (26 references) (auth)

26040 (GEAP-13824-6) LMFBR ALTERNATE SHUTDOWN SYSTEM DEVELOPMENT AND TESTING. Sixth Quarterly Report, April–June 1973. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jul 1973. Contract AT(04-3)-893. 35p. AT.

Design of the alternate shutdown system (ALSS) is described. Component testing is reviewed. Modifications are considered to adapt the ALSS to the Demonstration Plant configuration. The control assembly design was revised to satisfy current design recommendations, and 90%-enriched B_4C control material was shown to be feasible. Phase I damper tests were initiated and the test rig, test plan, and damper configurations are described. The Phase II damper tests and the latch tests are described. Analytical work was performed on the scram dynamic model and the sodium vapor trap. (7 references) (auth)

26041 (GEAP-13824-8) ALTERNATE SHUTDOWN SYSTEM. Eighth Quarterly Report, October–December 1973. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Jan 1974. Contract AT(04-3)-893. 23p. AT.

The design of the Alternate Shutdown System (ALSS) is described. The conceptual design layout drawings of the Secondary Control Rod System (SCRS) were completed for a drive configuration that is compatible with the Clinch River Breeder Reactor Plant. A preliminary FMEA was completed for the SCRS mechanism, drive line, and control assembly. (4 references) (auth)

26042 (GEAP-13824-9) ALTERNATE SHUTDOWN SYSTEM. Ninth Quarterly Report, January–March 1974. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Apr 1974. Contract AT(04-3)-893. 18p. AT.

Design of the Alternate Shutdown System (ALSS) is described. Candidate components are being selected for the drive mechanism. Fabrication of the Phase II Damper test rig was completed and fabrication of the latch test rig was initiated. Analysis efforts were focused on the dynamic performance of the control rod during scram and on the structural capabilities of the drive line and control assembly. 4 references. (auth)

26043 DYNAMICS AND CONTROL OF THE THORIUM HIGH TEMPERATURE REACTOR (THTR) POWER STATION. Bogorinski, P.; Friedrich, K.; Schutz, J.; Vollmer, H. (Hochtemperatur-Reaktorbau GmbH, Cologne). pp Paper No. 7 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

The THTR station is powered by an HTR fuelled with spheres containing highly enriched (U,Th) O_2 coated particles. Heat is removed from the core by circulating helium and transferred to the secondary circuit by six parallel steam generators feeding a common 300 MW turbine. Dynamic models for the plant and its components, core, steam generator, circulator, vessel internals, and turbine are briefly described. The dynamic behavior of the main components, core, and steam generator is investigated by step responses to reactivity, hot gas temperature and helium and feedwater flow. It is concluded that the core is inherently stable and responds quite slowly to perturbations owing to the large thermal capacity. By contrast the steam generator response is fast because of its small storage capacity. The requirements, selection, and layout of the control system are discussed. By analyzing step responses of the plant due to load changes, it is demonstrated that with the aid of the selected control system a well damped behavior of the plant may be achieved, thus meeting the specified control requirements. Further improvement of the control quality seems possible by proper refinement and optimization of the control system. (UK)

26044 EXPERIENCE FROM THE EXPERIMENTAL IMPLEMENTATION OF A MODERN CONTROL APPROACH ON A NUCLEAR SYSTEM. Blomsnes, B.; Grumbach, R.; Lunde, J. E. (Institutt for Atomenergi, Halden, Norway). pp Paper No. 19 of Boiler Dynamics and Control in Nuclear Power Stations, Proceedings of the International Conference Held on 22–23 March 1973 at the Institution of Civil Engineers, London. London, Eng.; British Nuclear Energy Society (1973).

From international conference on boiler dynamics and control in nuclear power stations; London, Eng. (22 Mar 1973).

Studies were conducted to investigate the applicability, for reactor control, of the linear optimization theory, i.e., the theory valid for white noise and subject to quadratic performance criteria, and also to obtain experience about more practical problems associated with the design of a control system based on this theory. The studies consisted of the design and experimental testing of an algorithm based on linear optimization theory for the control of the nuclear power and the reactor vessel pressure of the Halden boiling water reactor. A short description is given of the HBWR plant, and the control problem is stated in general terms. The procedure for deducing the control system is then described. The derivation of mathematical models of the HBWR and the development, testing, and operation of the control system are indicated. A description is also given of the experimental investigations. It is concluded that greatly improved control performance could not be obtained using this modern algorithm mainly because the coupling between the power control loop and the pressure control loop in the HBWR is too weak. (UK)

26045 ON LINE CALIBRATION OF REACTOR CONTROL RODS BY A PROCESS COMPUTER. Schwieger, E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). Atomkernenergie; 23: No. 3, 199-202(1974). (In German).

9 figs.; 7 refs.

The computer code described enables the on-line calibration of reactor control rods. The calibration is based on the rod drive method. The code was written for the process computer TR 86 in order to calibrate the control rods of the FRG-2 in short time. Experimental results are presented. The first operational experiences by the on-line calibration are good. (auth)

Nuclear Power Plant Economics

Refer also to abstract 25997.

26046 (CONF-730364-) IMPLICATIONS OF NUCLEAR POWER IN TEXAS. Proceedings of Symposium, Austin, Texas, March 1–2, 1973. (Texas Univ., Austin (USA)). 1973. 170p.

Information on the effects of nuclear power in Texas is presented concerning the overall energy needs of Texas, available fossil fuel resources, nuclear power plant concepts, reactor safety, state and federal regulations, and radioactive and thermal effluents. (DCC)

26047 (NP-20023) CO-ORDINATED EXTENSION OF POWER PLANTS IN THE 1980'S. A Statement Submitted to the Ministry of Commerce, Shipping, and Industry by the Energy Committee of the Power Plants. (Handelsministeriet, Copenhagen (Denmark)). Mar 1974. 33p. (In Danish). Dep. NTIS (US Sales Only) $4.75.

A statement from Denmark on the extension of power plants is presented and concludes that the capital involved will be of the same size for nuclear and conventional power plants. On the background of rising prices for fossil fuel the future energy pattern and energy development including their distribution upon energy raw materials must be set out. Nuclear energy is a suitable means of lessening Denmark's dependence upon oil and coal. The necessary capital should be acquired through self-financing, and foreign loans should be considered if necessary. If the activities of the power plants are tightened for financial reasons, reductions in electricity consumption must be considered in the not too distant future. (DE)

26048 (NP-20121) OSLO'S FUTURE POWER SUPPLY. (Oslo Lysverker, Oslo (Norway)). Jan 1974. 95p. (In Norwegian). Dep. NTIS (US Sales Only) $7.75.

In a general introduction the potential sources of energy are summarized and commented on. Environmental aspects are mentioned. Hydroelectric, fossil fuelled and nuclear power and combined power-district heating are discussed briefly. Following a short section on energy consumption in Norway, the energy supply situation in Oslo is described in some detail. Thereafter investments, financing and prices are discussed at some length. Finally a proposal for a program for the future development of the city's energy supply is presented. Two appendices present respectively a more detailed survey of energy sources and power plants, and Oslo Lysverker's price tariff. (NO)

26049 THE NUCLEAR POTENTIAL OF PAKISTAN IS LOW. Fent, P. VDI (Ver. Deut. Ing.) Nachr.; 28: No. 25, 1-2(Jun 1974). (In German).

1 fig.

The present nuclear situation of Pakistan is reported which may be characterized by an IAEA sponsored uranium prospection project and by considerations concerning the economic operation of small nuclear power plants. (GE)

26050 PRESENT STATE AND FUTURE TRENDS OF NUCLEAR POWER GENERATION. Hirano, M. (Ministry of International Trade and Industry, Tokyo). Haikan Gijutsu; 15: No. 13, 19-42(Sep 1973). (In Japanese).

With the recent situation of energy resources and the problem of environmental protection, the role of nuclear power generation is rapidly increasing. However, before nuclear energy is really harnessed, the problems to be solved are numerous, namely safety, environmental conservation, securing and efficient utilization of fuel, and waste disposal, and also the required technology must be incessantly improved or developed. In this connection, the following are described, reviewing the current state and future trends both overseas and in Japan: the need for nuclear power generation and future outlook; the trends in nuclear reactor development; the problems of nuclear fuel; safety and environmental conservation in nuclear power generation; and the trends in treatment and disposal of radioactive wastes. (JA)

26051 SYSTEMATIC APPROACH TO EVALUATE SITES FOR NUCLEAR POWER PLANTS. Fischer, J. A.; Ahmed, R. (Dames

and Moore, Cranford, NJ). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 7-8(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26052 METHODOLOGY AND CRITERIA USED FOR A NUCLEAR POWER PLANT SITING STUDY. West, L. J. (Dames and Moore, Cranford, NJ); Dyar, K. Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 8-10(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26053 ENVIRONMENTAL ASSESSMENT MATRIX AS A SITE SELECTION TOOL: A CASE STUDY. Tamblyn, T. A.; Cederborg, E. A. (Bechtel Power Corp., San Francisco). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 10-11(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26054 NUMERICAL RATING OF ENVIRONMENTAL IMPACTS FOR POWER PLANT SITING. Smith, H. L.; Heilman, W. L. (Commonwealth Associates Inc., Jackson, MI). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 11-12(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26055 QUANTIFICATION OF SITING FACTORS FOR RATIONAL SELECTION OF ALTERNATE SITES. Beer, L. P. (Environmental Science and Engineering, Inc., Gainesville, FL). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 12-14(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26056 SYSTEMATIC METHODS FOR POWER PLANT SITING STUDIES. Geitner, N. M.; Broome, K. R. (Gilbert Associates, Inc., Reading PA). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 14(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26057 AGRICULTURAL COST/BENEFIT ANALYSIS FAVORING COOLING PONDS FOR NUCLEAR POWER STATIONS. Cushman, R. A. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 28-30(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26058 SITING ALTERNATIVES FOR FLOATING NUCLEAR PLANTS. Bonsack, F. E. (Offshore Power Systems, Jacksonville, FL). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 30-31 (1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26059 UNDERGROUND NUCLEAR PLANT SITING: A TECHNICAL AND SAFETY ASSESSMENT. Doan, P. L. (United Engineers and Constructors Inc., Philadelphia); Crowley, J. H.; McCreath, D. M. Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 31-33(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26060 SITE SELECTION: A CONTINUING PROCESS AT COMMONWEALTH EDISON. Leitzell, K. D.; Naatz, R. A.; Rossin, A. D.; Wandke, N. E. (Commonwealth Edison Co., Chicago). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 37-38 (1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26061 NUCLEAR POWER PLANT SITING CONSIDERATIONS AND EXPERIENCES. Krishna, P. M.; Douglas, R. P. (Public Service Electric and Gas Co., Newark, NJ). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 38-39(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26062 NUCLEAR POWER PLANT SITING IN SOUTHERN CALIFORNIA. Fogarty, D. J. (Southern California Edison Co., Rosemead). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 40 (1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26063 DOUGLAS POINT DECISION: A CASE STUDY. Scoville, J. J. (Potomac Electric Power Co., Washington, DC). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 40-42(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26064 REGIONAL SITING SURVEY FOR THERMAL POWER PLANT SITES IN THE STATES OF OHIO. Elkins, M. L. (NUS Corp., Rockville, MD); DiNunno, J. J.; Morgan, P. V. Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 42-46(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26065 SITING OF POWER STATIONS IN FRANCE. Bellin, A.; Toureau, P. (Electricite de France, Paris). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 46-47(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26066 SOCIAL CONSIDERATIONS IN NUCLEAR POWER PLANT SITING: CHOOSING THE LEAST-SOCIAL-COST SITE. Peelle, E. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 50-51(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26067 METHODOLOGY FOR EVALUATING COMMUNITY ACCEPTANCE OF POWER PLANTS. Sucov, W. W. (Westinghouse Research Labs., Pittsburgh); Liang, C. K. Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 51-52(1974).
From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26068 RESEARCH AND DEVELOPMENT ON THE NUCLEAR ENERGY IRON MAKING IN JAPAN. Hayashi, T. (Kawasaki Steel Corp., Kobe, Japan). FAPIG (Tokyo); No. 70, 92-102(Aug 1973). (In Japanese).
Coal required for the making of iron and steel in Japan is mostly imported. With the fear concerning the adequacy of coal supplies following increased iron production, the utilization of nuclear energy for iron and steel making attracted attention some years ago. The studies in this connection were carried out for about five years starting in 1968 in the Iron and Steel Institute of Japan. In consequence of the studies, the necessity for the research and development on nuclear energy iron and steel making was appreciated by the Government. The subject, i.e., iron making by nuclear energy, has thus been started as a national project in the Agency of Industrial Science and Technology. Its final objective is to realize a unit iron-mill of 3,000,000 to 3,500,000 tons of raw steel per year, utilizing a multi-purpose HTGR with He-coolant outlet temperature about 1000°C. Since the project involves a wide range of technical developments, an ad hoc association to promote its smooth going was established. (JA)

26069 REMINDER AS ANSWER TO NOTE ON NUCLEAR ENERGY MANAGEMENT. Atoomenergie Haar Toepass.; 16: No. 5, 115-125(May 1974). (In Dutch).
It is expected that consumption of nuclear power will increase 5 fold in industrial countries between 1973 and 1980, and that by 2000 about 63% of the energy used in these countries will be of nuclear origin. Various forms of reactors will be developed, and there will be a need for a range of reactors for various purposes; the present equipment cannot be regarded as final. Safety and alarm problems will receive increasing attention. Research is continuing into nuclear physics in general and thermonuclear and fission problems in particular. Holland will play its full part in the development required for full exploitation of the possibilities of the future. (NL)

26070 PROGNOSIS AND PLANNING. de Boer, A. A. Atoomenergie Haar Toepass.; 16: No. 5, 108-114(May 1974). (In Dutch).
A summary of one of the chapters in the author's book "Energy Today and Tomorrow" is made. An account is given of the various methods available for forecasting of future trends, including the future demand for energy, both fossil and nuclear. Economic factors are stressed, so as to avoid the risk of using more energy in finding a source of fuel than is obtained from the fuel found. Models and methods of calculation can be devised to give accurate results within the limitations of their initial assumptions; but continual reexamination is required since the external factors may change and so invalidate the original assumptions. (NL)

Reactor Fuel Cycle Economics

Refer also to abstract 23971.

26071 WHO BELONGS TO WHOM IN THE GERMAN NUCLEAR INDUSTRY. P. 4. Shares and Interdependencies. Solfrian, W. (Bonnenberg und Drescher Ingenieurgesellschaft m.b.H., Juelich (F. R. Germany)). Atomwirtsch., Atomtech.; 19: No. 6, 309-315(Jun 1974). (In German).

5 figs.

The fourth and last sequence of this series deals with those firms working in the field of fuel cycles. The following are involved: uranium supply, uranium enrichment, fuel fabrication and refabrication. The ownership relations are examined in detail and shown in five diagrams. (GE)

Reactor Licensing and Regulation

Refer also to abstracts 25997 and 26119.

26072 (DOCKET-STN-50484-15) TYRONE ENERGY PARK, UNITS 1 AND 2. License Application. (Northern States Power Co., Minneapolis, Minn. (USA)). 26 Apr 1974. 54p. (DOCKET-STN-50487-15). Dep. NTIS $5.75.

A license application for two nuclear units is presented. The facility is to be located on a 4700 acre tract on the left bank of the Chippewa River about 19 miles west southwest of Eau Claire in Dunn County, Wisconsin. Each unit will utilize a pressurized water reactor which will supply 3425 MW(t) and 1150 MW(e). (FS)

26073 (DOCKET-STN-50502-1) WISCONSIN UTILITIES PROJECT, UNITS 1, 2, 3, 4, 5, AND 6. License Application. (Wisconsin Electric Power Co., Milwaukee (USA)). 2 Aug 1974. 123p. (DOCKET-STN-50503-1; DOCKET-STN-50504-1; DOCKET-STN-50505-1; DOCKET-STN-50506-1; DOCKET-STN-50507-1). Dep. NTIS $9.25.

An application for construction permits for standardized nuclear plants of the Wisconsin Utilities Project is presented. The specific sites will be described in time to permit their consideration with this application. Each unit will be a PWR with a power output of 2,775 MW(t). The gross output of the turbine generator is approximately 1000 MW(e). A steel lined reinforced concrete containment allows for normal operation at atmospheric pressure. (FS)

26074 (DOCKET-STN-50502-10) WISCONSIN UTILITIES PROJECT, UNITS 1 AND 2. License Application, PSAR, Volume 1, Site Addendum. (Wisconsin Electric Power Co., Milwaukee (USA)). 19 Aug 1974. 413p. (DOCKET-STN-50503-10).

The Koshkanog Nuclear Power Plant consisting of two PWR standardized Wisconsin Utilities Project reactors is described. The plant is to be located approximately one half mile east of Lake Koshkonong on the Jefferson-Rock county line in Jefferson County, Wisconsin. Unit No. 1 fuel loading is scheduled for November 1980 with commercial operation in February 1981. Unit No. 2 is schedlued for fuel loading in March 1982 and commercial operation in June 1982. The core output is 2,775 MW(t) and the turbine generator output is approximately 960 MW(e). (FS)

26075 (DOCKET-STN-50508-1) WPPSS NUCLEAR PROJECT NO. 3 AND NO. 5. License Application. (Washington Public Power Supply System, Richland (USA)). 30 Jul 1974. 128p. (DOCKET-STN-50509-1). Dep. NTIS $9.50.

An application to construct and operate two nuclear plants, at a site located in southeastern Grays Harbor County along the south bank of the Chehalis River near its confluence with the Satsop River in the state of Washington, is presented. Each unit will have a core power level of 3,800 MW(t). Cooling towers will be provided. (FS)

26076 (FIND-50334-R1) FIND: BEAVER VALLEY POWER STATION, UNIT 1. Items 1-123. Carter, E. P. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jul 1974. 46p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (JWR)

26077 (FIND-50445) FIND: COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Items 1-58, 67. RESAR-3: Items 22-29. Williams, W. H. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jul 1974. 27p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

26078 (FIND-STN-50447) FIND: STANDARD SAFETY ANALYSIS REPORT (GESSAR). Items 1-26. Horn, F. H. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jun 1974. 81p. Dep. NTIS $5.45.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DCC)

26079 (FIND-STN-50477) FIND: ATLANTIC GENERATING STATION, UNITS 1 AND 2. Items 1-23. Carter, E.; Horn, F.; Williams, W. (eds.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jul 1974. 54p. Dep. NTIS $5.45.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DCC)

26080 (PRDI-74-8) TITLE LISTING OF POWER REACTOR DOCKET INFORMATION. (USAEC Technical Information Center, Oak Ridge, Tenn.). Aug 1974. 53p. TIC $1.45.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the Atomic Energy Commission in support of applications for construction and operating licenses. Citations are listed by docket number in accession number sequence. The Table of Contents is arranged both by docket number and by power plant name. (JWR)

26081 (PRDI-74-9) TITLE LISTING OF POWER REACTOR DOCKET INFORMATION. (USAEC Technical Information Center, Oak Ridge, Tenn.). Sep 1974. 54p. Dep. NTIS $1.45.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the Atomic Energy Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (auth)

26082 (RDT-E-16-1T(8-74)) TEST VEHICLES FOR TRANSIENT REACTOR TEST FACILITY (TREAT) EXPERIMENTS CONTAINING SODIUM. (USAEC Division of Reactor Research and Development, Washington, D. C.). Aug 1974. 25p. RSO.

The requirements are presented for the design, fabrication and quality assurance of the test vehicle for sodium cooled experiments which will be subjected to short term testing in the Transient Reactor Test Facility (TREAT). (auth)

26083 (REG/G-1.70.3(2-74)) ADDITIONAL INFORMATION: RADIOACTIVE MATERIALS SAFETY FOR NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Feb 1974. 2p. DRS.

Information concerning radioactive materials safety which is to be included in safety analysis reports submitted for AEC review is enumerated. (DG)

26084 (REG/G-1.70.4(2-74)) ADDITIONAL INFORMATION: FIRE PROTECTION CONSIDERATIONS FOR NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Feb 1974. 2p. DRS.

Specific fire protection related information to be included in safety analysis reports submitted for AEC review is enumerated. (DG)

26085 (REG/G-1.70.5(5-74)) ADDITIONAL INFORMATION: WATER LEVEL (FLOOD) DESIGN FOR NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). May 1974. 2p. DRS.

Specific flood protection related information to be included in safety analysis reports submitted for AEC review is enumerated. (DG)

26086 (REG/G-1.88(8-74)) COLLECTION, STORAGE, AND MAINTENANCE OF NUCLEAR POWER PLANT QUALITY ASSURANCE RECORDS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Aug 1974. 2p. DRS.

A method acceptable to the AEC Regulatory staff is presented for complying with the Commission's regulations with regard to collection, storage, and maintenance of quality assurance records for nuclear power plants. The guide applies to all types of nuclear power plants. (DCC)

26087 (WASH-1265) STANDARD FORMAT AND CONTENT OF SAFETY ANALYSIS REPORTS FOR NUCLEAR POWER PLANTS. Revision 1. (USAEC Regulatory Staff, Washington, D.C.). Oct 1972. 237p. Dep. NTIS $15.00.

A guide is presented which provides a standard format for Safety Analysis Reports and identifies the principal information to be included. (DG)

26088 (WASH-1266) HTGR EDITION OF THE STANDARD FORMAT AND CONTENT OF SAFETY ANALYSIS REPORTS FOR NUCLEAR POWER PLANTS. (USAEC Regulatory Staff, Washington, D. C.). Jul 1973. 229p. Dep. NTIS $14.50.

The HTGR Edition of the "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants" was prepared for the purpose of supplying additional and supplementary guidance to the preparation of Safety Analysis Reports for HTGR's. The HTGR Edition recognizes explicitly the unique differences between HTGR's and water cooled reactors, but retains the material from the "Standard Format" that is generally applicable to both types. (auth)

26089 (WCAP-8291) REVIEW OF SELECT MATERIAL PROPERTIES FOR REACTOR PRESSURE VESSELS RELATIVE TO 10CFR PART 50, APPENDIX G. Yanichko, S. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). May 1974. 14p.

The methods by which Westinghouse intends to comply with AEC regulations which impose additional testing requirements beyond ASME Code provisions pertaining to fracture toughness requirements for pressure-retaining components of water cooled reactors are described. (DG)

26090 ACTION FOR ANNULMENT OF LICENSE FOR THE CONSTRUCTION OF FAST BREEDER REACTOR DISMISSED. Energiewirtsch. Tagesfragen; 24: No. 3, 145-151(Mar 1974). (In German).

The administrative court in Duesseldorf has dismissed two actions for annulment of the first partial license for the construction of a fast breeder nuclear power plant in the vicinity of the town Kalkar/Niederrhein. According to the almost identical judgments issued on October 30, 1973 the plaintiffs, two farmers living in that area, have been dismissed from their suits, the costs of the legal proceedings being awarded against the plaintiffs. The judgments are not yet final. Some of the grounds upon which the judgments are based are cited. (GE)

26091 PUBLICATION OF RECOMMENDATIONS OF THE REACTOR SAFETY COMMISSION (RSK) OF JANUARY 28, 1974. Bundesanzeiger.; 26: No. 48, 1-3(Mar 1974). (In German).

The recommendations of the reactor safety committee, submitted during the 81st to 86th meeting (1973) deal with the following nuclear installations or components: 1) Storage and evaporation facility of the WAK. 2) Engineered safeguards in the KKB for protection from chemical explosions. 3) THTR Schmehausen. 4) Welding problems regarding pressure vessels of LWR type reactors. 5) Water gas reactions in malfunctions in the AVR. 6) In-service inspections of the pressure vessel and engineered safeguards in the Kruemmel nuclear power plant. 7) Specifications for the fabrication of pressure vessels for LWRs. 8) Design of pipings for the KKW. 9) Increase to full-load operation of the KNK in May 1975. 10) Approval of design of the Kruemmel and Philpsburg-2 reactors. (GE)

26092 GOVERNMENT AND NUCLEAR POWER PLANT SITING. Davis, J. J. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 1-2(1974).

From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26093 THE THING IS THE SOCIETAL IMPACT. Bradley, L. B. (Washington State Dept. of Commerce Economic Development, Olympia). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 2-3(1974).

From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26094 SITE ACCEPTABILITY AND POWER AVAILABILITY: NEEDED INSTITUTIONAL CHANGES. Haggard, J. E. (Houghton, Cluck, Coughlin, and Riley, Seattle, WA). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 3-4(1974).

From conference on nuclear power plant siting; Portland, OR (25 Aug. 1974).

26095 PRACTICE AND EXPERIENCE OF SAFETY IN NUCLEAR PLANT SITING IN FRANCE. Candes, P. (CEA/CEN de Saclay, Gif-sur-Yvette, France). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 4-5(1974).

From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26096 GUIDE TO SITING OF NUCLEAR POWER PLANTS. Norris, J. A. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 6-7(1974).

From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26097 SITING ENVELOPE FOR STANDARDIZED PLANTS. Gilbert, W. D.; Quirk, J. F. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 35(1974).

From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26098 SITE SELECTION AND EVALUATION OF ALTERNATIVES BY UNITED STATES UTILITIES. Rossin, A. D. (Commonwealth Edison Co., Chicago); Nichols, B. L. Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 36-37(1974).

From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

26099 IMPACT OF ZONING ON NUCLEAR PLANT SITING. Stimac, M. V. (Puget Sound Power and Light Co., Bellevue, WA). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 1, 52-53(1974).

From conference on nuclear power plant siting; Portland, OR (25 Aug 1974).

GENERAL

Civilian Defense

Refer also to abstracts 24275 and 26129.

26100 (AD-774162/2GA) CONCEPT FOR POSTATTACK NUCLEAR EMERGENCY OPERATIONS. Final Report. Miller, C. F.; Laurino, R. K. (Dikewood Corp., Albuquerque, N. Mex. (USA)). Aug 1973. Contract DAHC20-72-C-0313. 114p. (DC-FR-1217-1). NTIS $4.50.

A general concept of postattack nuclear emergency operational planning has been evolved based primarily on the premise that events of importance in the postattack period will be generated more by decisions to take a particular course of action, in view of the existing situation and of recovery capabilities, rather than by responses to certain happenings in attack effects. Three general different conditions of recovery capability have been identified; (1) a non-sustain condition, (2) a sustain condition, and (3) a support condition. (GRA)

26101 (AD-775937/6) UNITED STATES POPULATION DATA METHODOLOGY: A DESCRIPTION OF THE METHODS USED TO DEVELOP NMCSSC POPULATION DATA ON THE UNITED STATES: 1970–1983. Hyams, D. J.; Strickler, P. T. (National Military Command System Support Center, Washington, D. C. (USA)). 1 Oct 1973. 263p. (NMCSSC-TM-6-73). NTIS $6.50.

The P-95 (urban) and cell (rural) population data for the United States furnished to the National Military Command System Support Center, Defense Communications Agency, by the Foreign Demographic Analysis Division, Bureau of Economic Analysis are considered. Basic data available are described, criteria used in classifying the population as urban or rural are given, and guidelines followed in drawing P-95 circles and assigning population to P-95 circles and basic and rural cells are presented. The national and regional projections of the U. S. population used as control totals and the techniques used to prepare projections of P-95 and cell populations are described. A list of urban places and P-95 circles is included. These population data are designed for use in nuclear war gaming, vulnerability and damage assessment analyses, and other special nonmilitary studies. (GRA)

26102 CIVIL DEFENSE ON FARMS. Zhivotnovodstvo; No. 10, 43(1972). (In Russian).

The book is intended for all departments of agricultural colleges and divisions of agricultural technical schools. Matters relating to the organization of civil defense to protect the population against weapons of mass destruction are discussed. Instruments used for radiation, chemical, and biological reconnaissance and monitoring as well as the equipment used for decontamination, plant protection, and veterinary treatment of animals are described. Steps civil defense should take to protect agricultural products in a nuclear war and how to organize and run rescue and emergency-repair operations are outlined. The handbook describes in detail methods of organizing civil defense in agricultural enterprises. Recommendations are offered on the preparation and conducting of civil defense exercises and on the organization and method of training the population. The book can be a guide for the civil defense units. (JPRS)

26103 BOR'BA S POZHARAMI NA OB'EKTAKH NARODNOGO KHOZYAISTVA V USLOVIYAKH YADERNOGO PORAZHENIYA. (Fire Prevention in Objects of National Economy Under Conditions of Nuclear Attack). Mashevskii, V. F. (ed.). Moscow; Voennoe Izdatel'stvo Ministerstva Oborony SSSR (1973). 223p.

Methods of attack causing massive fires are examined. Methods for determining possible fire conditions in units and the area surrounding them are discussed. Fire patterns and methods of extinguishing them at the site of nuclear attack are shown. Counter measures to provide security to installations of national economy are emphasized. (tr-auth)

Energy Utilization and Economics

26104 (LA-UR-74-821) GEOTHERMAL ENERGY: A NEW APPLICATION OF ROCK MECHANICS. Roegiers, J. C.; Brown, D. W. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 15p. (CONF-740909-2). Dep. NTIS $4.00.

From 3rd international congress on rock mechanics; Denver, Colorado, USA (1 Sep 1974).

A small group of scientists from the Los Alamos Scientific Laboratory has been working for the past 2 years in developing a new energy source based on the earth's heat. Their concept, the extraction of thermal energy from the numerous regions of the earth's crust containing hot—but essentially dry—rock at moderate depths, may offer a solution to the developing world energy crisis. A deep exploratory hole has already been drilled into basement crystalline rock in north-central New Mexico, and tested at various horizons. These experiments have demonstrated, at least in this one specific region, that a large vertical fracture system can be created in granitic rocks using conventional-hydraulic-fracturing techniques. Of more importance relative to the Los Alamos convective energy extraction concept, an open pressurized fracture system has been maintained in these crystalline rocks for many hours with only negligible fluid leak off. Further, an analysis of seismic signals resulting from the hydraulic fracturing process indicates that a method may be available to determine both the orientation and vertical extent of the resulting fracture system. In conjunction with the in situ tests, theoretical and laboratory studies have been undertaken in order to fully understand the different features observed in the field fracturing experiments. Permeability tests under various stress conditions have revealed the importance of this factor, and have drastically changed the procedure for measuring stress at great depths using the hydraulic fracturing technique. Geochemical problems associated with the dissolution of certain minerals are also being investigated. The variation in concentration of the materials contained in a closed-loop fracture circulation system could be an indicator of the fracture extension rate due to thermal contraction of the reservoir rock as energy is withdrawn from it. This concept, however, must be tested and will be investigated in a subsequent field experiment. (auth)

26105 (ORNL-EIS-74-52(Vol. 2)(No. 5)) NSF-RANN ENERGY ABSTRACTS. A Monthly Abstract Journal of Energy Research. Guthrie, M. P. (ed.). (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 46p. Dep. NTIS $5.50.

Bibliographic citations with abstracts are presented for 105 publications concerning energy and energy sources including supply, demand, research, policy, consumption, forecasting, management, and environmental problems. The publications cited are technical journal articles, popular or semi-technical magazine articles, topical reports, symposium papers and proceedings, monographs, and books. (SFL)

26106 (UCID-16520) AEC IN SITU OIL SHALE PROGRAM. Kahn, J. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jun 1974. Contract W-7405-Eng-48. 16p. Dep. NTIS $4.00.

In order to make use of the vast oil shale deposits of the Western U. S., the AEC recommends an accelerated program to develop the technical base essential to the commercialization of a modified in situ technology. A void volume is created by mining a portion of the oil shale deposit and rubblizing the rock above the volume. The rubble zone is then retorted underground. Technical and economic analysis of these field programs would determine the commercial feasibility of the process. If feasibility is determined, the field program would be scaled up to larger volumes. The following technical issues have been identified as critical to commercial feasibility: 1) determination of minimum porosity; 2) determination of rubblization procedures to achieve minimum porosity; 3) determination of process variables affecting maximum retort rates, highest conversion efficiency and optimum product quality; 4) control of process parameters; 5) identification and resolution of mine safety issues; 6) identification of key environmental issues; 7) analysis of the operation of the total retorting system; and 8) the demonstration of the process on a commercial scale and technology transfer. These technical issues will be resolved by a two phase field program, a laboratory process development program and an instrumentation development program. Joint industry government participation is deemed desirable. Discussions with several industrial groups are currently being held. No industry commitments have been made to date. For this reason the program at present is envisioned as a completely funded government program among AEC laboratories and the U. S. Bureau of Mines. Although industry participation can be accommodated at any stage of this proposed work, it is recommended that joint participation be accomplished at least by the commercial-scale demonstration phase. (auth)

26107 (UCID-16572) SOLAR RADIATION MODEL RAD1. Luther, F. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Aug 1974. Contract W-7405-eng-48. 13p. Dep. NTIS $4.00.

In the solar radiation model, RAD1, the radiative transfer equa-

tion for a cloudless, plane-parallel atmosphere is solved using the successive-scattering iterative procedure of Davé and Gazdag in which the scattering phase function is expressed in a Fourier series. The model includes Rayleigh and Mie scattering along with absorption by aerosol, ozone, water vapor, carbon dioxide, and oxygen. The solar spectrum is divided into discrete spectral intervals (83 in the present model), and the vertical column is divided into up to 500 layers depending upon the optical thickness of the atmosphere. The direct solar flux and the upward and downward diffuse fluxes for each spectral interval at each level are computed taking into account all orders of scattering. (auth)

Information Handling

26108 (EUR-5169-e) USER REACTIONS TO CAIN (CATALOGING AND INDEXING DATA BASE OF THE BIBLIOGRAPHY OF AGRICULTURE). Campey, L. H. (Commission of the European Communities, Luxembourg). 1974. 56p. Dep. NTIS (U. S. Sales Only) $6.00. EUR B. Fr. 70.-.

The results of discussions and correspondence with ten out of twelve known subscribers to CAIN, including the producers of the Bibliography of Agriculture are described. They cover both the performance of the data base and user reactions to it and they are discussed under the following headings — coverage, accessibility, suitability for selective dissemination of information, and suitability for retrospective searches. The report concludes that CAIN provides good coverage of the agricultural literature, including a substantial amount of useful fringe material, but that it must be supplemented by alternative services for complete coverage. Items in CAIN are frequently difficult to access, so that the formulation of search profiles normally requires considerable skill and effort. With these reservations CAIN can give acceptable results on SDI and retrospective searches when professional assistance in profile construction is available. The report also includes general observations on the implications of these results for AGRIS. (auth)

26109 (KFK-1948) PROCESSING OF METEOROLOGICAL DATA AND PRESENTATION OF THE STORAGE DEVICES. Nagel, D.; Thomas P. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). Apr 1974. 11p. (In German). INIS.

16 figs.; 1 tab. With abstract in German and English.

The organization is described of the meteorological data acquired at the 200-m high meteorological tower of the Karlsruhe Nuclear Research Center. This includes the FORTRAN-IV programs allowing the processing ordering, checking and storage of these data following reduction and transfer. The storage devices like magnetic tape and list are presented and the data structures are described. (auth)

26110 (P.A.U.M-25) COLLECTED ESSAYS BY P.A.U. AUTHORS. (Ministry of Technology, Chilton (UK). Programmes Analysis Unit). 1974. 231p. Dep. NTIS (US Sales Only) $14.75. UK Pounds 4.

PAU (Programmes Analysis Unit) is principally concerned with the conduct of appraisal and assessment in practical decision situations for the Department of Industry and the Atomic Energy Authority. Valuable information from experiences from many sectors is presented in the papers. (MCW)

26111 (RT/EDP-(74)5) INFORMATION SYSTEMS: CONSTRUCTION OF DATA BASES AND ORGANIZATION PROBLEMS. Teolis, A. G. B.; Valentini, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Mar 1974. 15p. (In Italian). Dep. NTIS (US Sales Only) $4.00.

After a brief technical discussion about data bases concepts, the first organizational problems involved in operating an information system are introduced. (tr-auth)

26112 (TID-4552-R9) SUBJECT SCOPE OF NUCLEAR SCIENCE ABSTRACTS. (USAEC Technical Information Center, Oak Ridge, Tenn.). Jul 1974. 78p.

The publication defines the subject scope and arrangement of the literature in NSA. Nuclear science is defined as the study of the production, properties, and phenomena of atomic nuclei, subatomic particles, and nuclear radiation. Nuclear technology is the application of nuclear science to other sciences and engineering, and the application of other sciences and engineering to the problems of nuclear science. NSA covers reports, journals, books, patents, reviews, theses, conferences, and other similar literature. (MCW)

Law

Refer also to abstracts 23973 and 26090.

26113 (AED-CONF-73-670-004) THE INFLUENCE OF DIFFERENT IRRADIATION PROTECTION REGULATIONS ON THE INTERNATIONAL COMPETITION IN RADIOLOGICAL TECHNOLOGY. Berger, H. (Siemens A. G.; Erlangen (F. R. Germany)). 1973. 12p. (In German). INIS.

From working meeting on international and European law; Goettingen, F. R. Germany (22 Nov 1973).

The role of technical specifications in the international radiation protection law is considered. Technicians should observe the necessary regulations and the regulatory bodies should take into account and observe the principles leading to the accepted technical specifications. By this, commercial hindrances can be reduced, which complicate the competition among manufacturers of radiological equipment. (GE)

26114 INDICATIONS FOR THE APPLICATION OF THE X-RAY ORDINANCE. 2nd Communication by the BMJFG and the BMA of March 15, 1974 - BMJFG 333-4552-04 und BMA III b 6-3882.4030-1519/74. Bundesgesundheitsblatt; 17: No. 8/9, 113-140(Apr 1974). (In German).

3 figs.; 2 tabs.; 8 refs.

Regulations concerning methods and extent of personnel dose measurements and dose evaluation according to paragraph 40 of the X-Ray Ordinance are listed. Regulations concerning records to be kept according to paragraph 29 of the X-Ray Ordinance and rules for the performance of follow-up measurements as stipulated in paragraph 13 section 2 of the X-Ray Ordinance are given. Instructions are also set out concerning radiation protection measures in the repair and maintenance of television equipment. Training courses in radiation protection officially recognized as radiation protection courses prior to the coming into force of the X-Ray Ordinance are listed. These rules, instructions and the compilation were published in accordance with the highest authorities supervising the application of the X-Ray Ordinance of March 1, 1973. (GE)

26115 PROBLEMS OF INTERNATIONAL COOPERATION IN NUCLEAR FIELD. Ursu, I. (Institutul de Fizica Atomica, Bucharest). pp 471-508 of Energia Atomica. Bucharest; Editura Stiintifica (1973). (In Rumanian).

There is a general desire of the peoples all over the world to take advantage of the benefits of atomic energy and that is reflected in the efforts of each nation and in international cooperation. (tr-auth)

26116 REGULATIONS FOR PREVENTION OF IONIZING-RADIATION INJURIES TO SEAMEN. Genshiryokusen; No. 118, 2750-2768(Aug 1973). (In Japanese).

Regulations for the prevention of ionizing-radiation injuries of seamen, on the basis of Seamen's Law, were issued as ordinance No. 21 of the Transportation Ministry and are given. They consist of the following chapters: general provision, radiation control area, the limitation of exposure dose, the measurement of exposure dose, the prevention of exposure to external radiation, the prevention of contamination due to radioactive substances, measures taken at the time of accidents, health control, the obligatory items of seamen, and miscellaneous rule; and additional provisions. (JA)

26117 LAWS ON NUCLEAR POWER GENERATION. Takeda, K. (Ministry of International Trade and Industry, Tokyo). Karyoku Genshiryoku Hatsuden; 24: No. 5, 573-580(May 1973). (In Japanese).

In the recent political measures toward various industries, the elimination of public hazards and the conservation of environment are requested most strongly. These aspects in nuclear power generation are relatively well observed, due to its historical background, however. Laws and regulations and procedures enforced on electric power enterprises in Japan are explained, regarding the planning, construction, operation, and maintenance of nuclear power plants. As statutory provisions in Japan, there are the Electric Enterprise Law, the Atomic Energy Law, and the Law Regulating Nuclear Reactors. The procedures involved are as follows: presentation of plan for nuclear power plants, examination on the incorporation into the basic plan for power resource development, application for the shift to nuclear power generation, approval of construction program, inspection during and after construction, and regular inspection of nuclear power plants. (JA)

26118 ENVIRONMENT AND THE LAW. Yannacone, V. J. Jr. (Yannacone and Yannacone Law Firm, Patchogue, NY). Forum (Chicago); 9: No. 5, vp(Sum 1974).

A short summary is given of the history of environmental litigation and details of several cases concerning environmental contamination by chemicals, protection of national natural resource treasures, and underground nuclear explosions are reviewed. Comments are given on the issues raised in the Project Rulison legal actions. (SFL)

26119 GENERIC HEARINGS: PREPARATION FOR THE FUTURE. Lieberman, J. (George Washington Univ., Washington, DC). At. Energy Law J.; 16: No. 2, 141-174(Sum 1974).

The hearing process, which provides input to the licensing process from other than the Regulatory Staff, is considered. The concept of generic hearings is proposed and discussed. Purposes of licensing hearings are described and the current hearing structure reviewed. Present alternatives and recommendations are given. (MCG)

26120 PLOWSHARE: A TECHNOLOGY IN SEARCH OF A USE. Roncalio, T. (Congress, Washington, DC). At. Energy Law J.; 16: No. 2, 93-140(Sum 1974).

From Tri state energy conference; Denver, CO (1 Feb 1974).

The history and status of the process is reviewed. Project Gnome, excavation by nuclear blasting, nuclear natural resource recovery, nuclear stimulation of oil from shale and tar sands, nuclear stimulation of natural gas (Projects Gasbuggy, Rio Blanco, Wagon Wheel, and Rulison),contamination and radiation hazards, and economics are discussed. (101 references). (MCG)

Management

Refer also to abstract 23739.

26121 (CNAEM-107) CEKMECE NUCLEAR RESEARCH CENTER PROGRESS REPORT FOR THE YEAR OF 1972. (Cekmece Nuclear Research Center, Istanbul (Turkey)). 1972. 126p. (In Turkish). INIS.

The activities of Cekmece Nuclear Research and Training Center during 1972 are summarized. There are nine sections in this organization. The physics section consist of the plasma physics, nuclear physics, and solid state physics. The chemistry section does research on radiation chemistry, activation analysis, and coordination chemistry. The main interest of the nuclear engineering section is to develop a sufficiently advanced nuclear technology before the realization of the nuclear power plants in the country. The research activities of the radiobiology section are on cell biology, plant biology and radioecology. The operations section of the reactor is responsible for the working and maintenance of MW TR-1 Reactor. The health physics section has a research and development program parallel with routine work. The radioisotope production section has produced radioisotopes 165.15ci total activity during the current year; most of these were used in hospitals. The electronics section, along with maintenance and repair and production services, has also prepared the plans and manufactured various new electronic devices. The workshop section has helped in various research projects. A list of CNAEM Publications in 1972 is given. (auth)

26122 (NP-20063) NEA SECOND ACTIVITY REPORT, 1973. (Nuclear Energy Agency, 75 – Paris (France)). 1973. 65p. Dep. NTIS (U. S. Sales Only) $6.25.

Changes involved in a greater policy orientation in 1973 in the OECD included increased attention to radiological protection, safety of nuclear installations, radioactive waste management, and the basic legal and administrative framework necessary for the satisfactory regulation of problems in these fields. Preliminary work was begun towards improved public understanding of nuclear energy. Progress continued on the two experimental reactor projects, Dragon and Halden. Japan joined NEA's Coordinating Group on Gas-Cooled Fast Reactor Development. NEA's principal concern during the year with Eurochemic (the European Company for the Chemical Processing of Irradiated Fuels) was in connection with a series of complex negotiations on the future of the company. The International Programme in the Field of Food Irradiation recorded progress with the wholesomeness testing programs being carried out on foodstuffs by irradiation. The work of the Neutron Data Compilation Centre at Saclay and the Computer Program Library at Ispra continued to increase during the year. Japan's accession to NEA in 1972 was followed on Oct. 1, 1973, by that of Australia. (MCW)

26123 (NP-20115) ANNUAL REPORT OF THE DEPARTMENT OF ATOMIC ENERGY, 1973–1974. (Department of Atomic Energy, Bombay (India)). [nd]. 178p. Dep. NTIS (U. S. Sales Only) $12.00.

Progress in atomic energy in India is reported with brief descriptions of all atomic installations and the supporting industries. Programs in the divisions of the Department of Atomic Energy are given for Bhabha Atomic Research Centre; Reactor Research Centre, Kalpakkam; Atomic Minerals Division; Atomic Power Authority; Power Projects Engineering Division; Nuclear Fuel Complex; Heavy Water Projects; Industrial Operations; Directorate of Purchase and Stores; Tata Memorial Centre; Tata Institute of Fundamental Research; Saha Institute of Nuclear Physics; Publicity; International Relations; and the Programme Analysis Group. (MCW)

26124 (NP-20117) ANNUAL REPORT AND ACCOUNT, 1972/1973. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 39p. Dep. NTIS (US Sales Only) $5.00.

Progress is reported on the production systems of nuclear energy, on safety, and on utilization of radiation by the Japan Atomic Energy Research Institute. Research and development on the fast reactor, multi-purpose high temperature gas-cooled reactors, gas-cooled fast reactor, nuclear fusion reactor, and the LWR-type reactors are summarized. Research on reactor engineering safety and radioactive waste management are reported. Reports are included on radiation chemistry, food irradiation, and radioisotope production and use. Management and financing are discussed. (MCW)

26125 (SAND-74-0051) HUMAN FACTORS ASSOCIATED WITH PRESCRIBED ACTION LINKS. Swain, A. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 41p. (CONF-630409-1). Dep. NTIS $5.25.

From military operations research symposium; Annapolis, Maryland, USA (30 Apr 1963).

A human-factors reliability analysis was performed for the Air Force Special Weapons Center on typical aircraft/nuclear-weapon systems to evaluate the effect on weapon-system reliability of human factors associated with prescribed action link (PAL) systems. The analysis represents an application of a human factors technique, THERP (Technique for Human Error Rate Prediction), used by Sandia Laboratories. (auth)

26126 (SLA-74-0231) TONOPAH TEST RANGE. Datz, K. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 42p. Dep. NTIS $5.25.

The Tonopah Test Range is an extensively instrumented test range, with a large secure land area and controlled air space operated to test and evaluate both new and operational weapon systems. The brochure was prepared to inform potential users about TTR's test capabilities and current range facilities, the major items of which include hard and soft targets (dry lakes), rocket launchers and cannons, electronic and optical tracking systems, photographic recording systems, telemetry receiving systems, and meteorological measurement equipment. Many of the major instrumentation tracking systems are mobile, allowing a large degree of freedom and flexibility to more precisely meet the specific requirements of test engineers. Both routine and unusual tests are scheduled and engineered by direct contacts between test engineers and the Range Operations Division. Tests requiring stringent meteorological conditions are normally backed up with test "windows" on succeeding days. Data-gathering and reduction instrumentation and support facilities allow quick-look data to be made available to the test engineer on the day of the test. (auth)

26127 (SURRC-50/74) ANNUAL REPORT, 1972–73. Wilson, H. W. (Scottish Research Reactor Centre, East Kilbride (UK)). 1973. 40p. Dep. NTIS (U. S. Sales Only) $5.00.

Operation and development of the SRRC-UTR-100 Reactor are reported for 1972-73. Research progress at the Centre is reported on nuclear engineering and heat transfer, physics, radiochemistry, isotope production, health physics and nuclear medicine, isotope geology, and radiocarbon. Electronics developments are summarized. Educational and conference data are presented and a listing of eighty-five papers authored by Reactor Centre staff members is published. (MCW)

26128 (UKOR-109(O)) SOUTH AFRICA'S POSITION IN THE WORLD NUCLEAR ENERGY PICTURE. Roux, A. J. A. (Uranium Enrichment Corp. of South Africa, Ltd., Pretoria). 1973. 20p. INIS.

From sectoral industrial congress of the Afrikaanse Handelsinstituut; Johannesburg, South Africa (1 May 1973).

The case for basic research in a nuclear organization is examined and criticisms often levelled at fundamentalists by interested observers of applied research will find their answers in the very pertinent views expressed. (auth)

26129 (WASH-1274) GUIDANCE AND INFORMATION ON NUCLEAR WEAPONS ACCIDENT HAZARDS, PRECAUTIONS AND EMERGENCY PROCEDURES. (Department of Defense, Washington, D. C. (USA)). [nd]. 9p. GPO $0.25.

Unclassified information is presented on safety precautions, potential health hazards, and emergency procedures applicable at the scene of an accident involving nuclear weapons. (auth)

26130 PRESENT STATUS OF THE ATOMIC ENERGY DEVELOPMENT AND ITS UTILIZATION. Murata, H. (Japan Atomic Energy Research Inst., Tokyo). Nenryo Kyokai-shi; 53: No. 562, 73-82(Feb 1974). (In Japanese).

The energy crisis has been a most vital problem all over the world. Atomic energy is expected to be one of the most hopeful solutions for the present energy crisis. This article describes the features of atomic energy and includes world history and

present status of (1) light-water, gas-cooled, heavy-water, and fast breeder power reactors; (2) commercial nuclear power plants of which 124 are in operation as of the end of 1972; (3) multipurpose uses of atomic energy containing some examples such as use for chemical process heat, breeding of fishes and prawn, district heating, desalination, steel making, and hydrogen production; (4) controlled thermonuclear fusion which is expected to be an ultimate energy source for mankind; and (5) future trend of the development of atomic energy. (auth)

26131 ALL ORGANIZATIONS DRAW UP WORK PLANS FOR 1973. At. Jap.; 17: No. 6, 18–22(Jun 1973).

Research and development plans for the four major nuclear organizations in Japan, i.e. PNC, JAERI, JNSDA, and NIRS, are reviewed for FY-1973. Power Reactor and Nuclear Fuel Development Corporation (PNC) carries out development of uranium enrichment techniques, reprocessing plants and construction of FBR and ATR. Japan Atomic Energy Research Institute (JAERI) undertakes safety studies, nuclear fusion research and radiation application; also, studies are made on nuclear reactors and cooperation in national projects. Japan Nuclear Ship Development Agency (JNSDA) gives priority to the test run of N.S. Mutsu and building of definite anchorage and approved ports of call. National Institute of Radiological Sciences (NIRS) plans to explore the effects of environmental radioactivity, and to fully analyze the results of their five-year project. (JA)

Mathematics and Computers

Refer also to abstracts 23549 and 24286.

26132 (AEEW-M-1245) FODES: TECHNIQUE FOR SOLVING FIRST ORDER DIFFERENTIAL EQUATIONS. Street, C. M. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Jan 1974. 25p. Dep. NTIS (U. S. Sales Only) $4.25.

FODES is a digital computer program that is used to solve sets of first order differential equations by the use of a modified version of the Crank Nicolson scheme. A full description of the method and instructions for the use of a KDF9 version of the program are given. Analytical and numerical comparisons are made between FODES and the FIFI program, which uses a step by step predictor-corrector method. For the particular examples considered, it is concluded that FODES is faster and more accurate. (auth)

26133 (BNL-19060) CRYSNET, A CRYSTALLOGRAPHIC COMPUTING NETWORK WITH INTERACTIVE GRAPHICS DISPLAY. Meyer, E. F. Jr.; Morimoto, C. N.; Villarreal, J.; Berman, H. M.; Carrell, H. L.; Stodola, R. K.; Koetzle, T. F.; Andrews, L. C.: Bernstein, F. C.; Bernstein, H. J. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 13p. (CONF-740652-1). Dep. NTIS $4.00.

From conference on the computer as a research tool in the life sciences; Aspen, Colorado, USA (24 Jun 1974).

26134 (CEA-N-1712) MONOPARAMETRIC ACQUISITION PROGRAM FOR PLURIMAT SYSTEMS. 8K Program with Overlay. Lefevre, R.; Richard, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Services d'Electronique). 8 Oct 1973. 85p. (In French). (SES-PUB-SEG-73-203). Dep. NTIS (US Sales Only) $7.25.

The monoparametric acquisition PLURIMAT system is presented, and the various parameters accessible to the user and their part in processing of different tasks are specified. Modalities concerning insertion of these various parameters (user-computer dialogue) and processing of different feasible tasks are detailed. In particular, the principles of calculus applied to treatment of spectra stored in memory and formats used for different input-output peripheral devices coupled to the system are specified. (FR)

26135 (DP-1351) DESK-TOP MICROCOMPUTER. Byrd, J. S. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Aug 1974. Contract AT(07-2)-1. 70p. Dep. NTIS $5.45.

A low-cost desk-top microcomputer was designed and fabricated using an Intel Model 8008 central processor module. Programs can be sequentially loaded into a 2K × 8-bit random access memory with an octal data entry keyboard. Other key operations include single-point and sequential data readout, clear data entry, program interrupt, and program single cycle operation. Programs can be permanently stored in a 1K × 8-bit programmable read-only memory. All circuits were realized with plug-in dual in-line integrated circuit modules and wire-wrap connections. Applications of the microcomputer as a training aid and for process control are discussed. A control program that operates a process simulator chassis is also discussed. Several test programs are included in the appendices. The list of references is a bibliography on microprocessors through September 1973. (auth)

26136 (JAERI-M-5526) ANALYSIS AND CONSTRUCTION OF COMPILER OF A PROGRAMMING LANGUAGE BY PRECEDENCE GRAMMAR WITH PRECEDENCE FUNCTIONS. Asai, K. (Japan Atomic Energy Research Inst., Tokyo). Jan 1974. 122p. NTIS (U. S. Sales Only).

Construction of third-generation computers with versatile software concepts and facilities requires tremendous manpower and time. To cope with the problem, languages suitable for software construction must be found. GPL is one of these system description languages; it is a modified version of the PL360. It is a precedence language with precedence functions. The implementation techniques of a GPL compiler and usefulness of the language are described. (auth)

26137 (JINR-11-7356) BESM-6 STANDARD FILE TRANSLATION INTO THE MADLEN LANGUAGE. Lomidze, O. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 10p. (In Russian). INIS.

The program examined translates the standard files (the load block) into the Madlen language (autocode of the BESM-5). In the BESM-6 system of a translator with high-level languages (ALGOL type) with direct output to the standard files, the program given can be used to obtain the autocode form of the program. It can be used for recovery of lost or obsolete texts. (tr-auth)

26138 (JINR-D10-7707) MEETING ON PROGRAMMING AND MATHEMATICAL METHODS FOR SOLVING THE PHYSICAL PROBLEMS, DUBNA, 30 OCTOBER–4 NOVEMBER 1973. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 564p. (In Russian and English). (CONF-731082-).

The collection includes reports on the following problems: mathematical methods for solving physical problems, software and hardware for computers, filmless handling of experimental data, and modular program system for data handling. (auth)

26139 (JINR-E4-8084) SOLVABLE MODEL FOR RANDOM SYSTEMS INCLUDING OFF-DIAGONAL DISORDER. John, W.; Schreiber, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 21p. Dep. NTIS (U. S. Sales Only) $4.25.

Anderson's model for disordered systems is considered in the case in which the transfer matrix elements fluctuate according to a Lorentzian distribution. It is shown that the exact ensemble averaged Green function may be obtained if the energy level on each site depends linearly on the overlap integrals. Using this result the stability of amorphous Heisenberg ferromagnets is studied. The Weaire model of an amorphous covalent semiconductor with fluctuating matrix elements is considered. Numerical results for the density of states are given. (auth)

26140 (JINR-P5-7242) STABILITY OF DIFFERENCE BOUNDARY VALUE PROBLEMS WITH TWO BOUNDARIES. Serdyukova, S. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 9p. (In Russian). INIS.

The stability of difference boundary problems with two boundaries was studied. The operator of the transition from layer to layer was designated by G. For parabolic systems, the evaluation of $||G^n|| \leq c_1$, $n \leq c_2 N^\omega$, $\omega > 1$, was indicated. An example was given of a parabolic system with order of growth $||G^n|| \alpha \sigma^{n/N}$, $\sigma > 1$. Examples with orders of growth $||G^n|| \alpha \sigma^{n/N}$ and $||G^n|| \alpha$ n/N were constructed for hyperbolic systems. (tr-auth)

26141 (KAPL-M-7325) UTILITY PLOTTING MODULES. Kopp, H. J.; DiStefano, R. P.; Hennig, B. L.; Hodgins, C. N.; Lord, A. N.; Binney, E. J. (Knolls Atomic Power Lab., Schenectady, N. Y. (USA)). May 1974. Contract W-31-109-Eng-52. 74p. Dep. NTIS $6.75.

Input instructions for four utility plotting programs are presented. PLOT1 and PLOT2 apply to a function of one variable, f(x), whereas PLOT3 and PLOT4 apply to a function of two variables, f(x,y). PLOT3 produces contour and/or perspective plots for data specified on a regular grid. PLOT4 produces contour plots for data specified on an irregular grid. These computer programs are DATATRAN modules. (auth)

26142 (KFKI-74-26) ENHANCEMENT OF REDUNDANCY IN HOLOGRAMS OF BINARY CODED DATA BY WIDENING OF THE FOURIER SPECTRUM. Bencze, G.; Varga, P. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The storage redundancy in Fourier holograms of a binary mask was investigated in the case of each bit of the mask being illuminated separately by an identical form beam. The divergent beam illumination was found to be satisfactory for reaching the required storage redundancy. (auth)

26143 (KFKI-74-40) MARKOV CHAINS, HOMOGENEOUS IN THE SECOND COMPONENT. Gergely, T.; Yezhow, I. I. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1972. 30p. Dep. NTIS (U. S. Sales Only) $4.50.

The Markov chain homogeneous in the second component (MCHSC) is introduced as a two-dimensional process $\{\xi_n, \eta_n\}$ with the state space TxN, where $T = \{\alpha\}$ is a finite or countable set $N = \{0, \pm1, \pm2, \ldots\}$, and with the following transition probabilities: $P\{\xi_n = \beta, \xi_n = k/\xi_{n-1} = \alpha, \eta_{n-1} = r\} = p_{\alpha\beta}^{[n-1,n]}(k-r)$. This process is also a sequence of sums of independent random variables on the Markov chain $\{\xi_n\}$. The Markov chain $\{x_n, y_n\}$ with the state space TxN, none of whose positive discontinuities differs from the unit but whose negative discontinuities are arbitrary, is investigated. A process $\{z_n, \tau_n\}$ is introduced, which describes the first passage time over a fixed level for $\{x_n, y_n\}$. Not only is the relation between $\{x_n, y_n\}$ and its corresponding $\{z_n, \tau_n\}$ determined: but the matrix equation describing the distribution of the time point when the second component $\{y_n\}$ passes over a fixed level as well. The special case, when $\{x_n, y_n\}$ is homogeneous MCHSC is investigated. For this case a matrix transcendental equation is introduced to find the characteristic matrix of the process $\{z_n, y_n\}$ corresponding to $\{x_n, y_n\}$. The solubility of this equation is discussed. Finally, the system of equations describing the distribution of the maximum of the second component of the MCHSC in a given interval is determined. (auth)

26144 (MHSMP-74-26) DRUM SCANNER/COMPUTER SYSTEM. Progress Report. Black, L. W.; Harris, C. L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Jul 1974. Contract DA-11-173-AMC-487(A). 31p. Dep. NTIS $4.75.

The selection, analysis, justification, acquisition, installation, and programming of a system designed to evaluate photographic negatives was pursued. The need for this system evolved through process development of the MC2058. Specifically, the system was chosen to check for minute flaws in high explosive material via radiographic inspection. The equipment is installed and in programming status. The basic hardware, the software development plan, programming in progress, a projection of planned uses, and a hint of potential uses are discussed. Included are exhibits of actual density data and photographs. (auth)

26145 (ORO-4061-3) GEDANKEN MACHINES. Feustel, E. A. (Rice Univ., Houston, Tex. (USA). Lab. for Computer Science and Engineering). 31 Jan 1972. Contract AT(40-1)-4061. 47p. Dep. NTIS $5.50.

It is proposed that all data elements in a computer memory be self-representing. Each element is tagged directly or the access path to the element gives an effective indirect tag. The advantages of the change from the traditional Von Neumann machine to the tagged architecture propagate through all software areas including programming systems, operating systems, debugging systems, and instrumentation. Although the additional costs of memory and processor have not been explicitly calculated, it appears that the improvement in costs of software and the potential for increasing the security and efficiency of the whole computer system justify the additional costs. It is concluded that the tagged architecture should replace the Von Neumann architecture on large general purpose machines. (auth)

26146 (ORO-4061-5) ADVANTAGES OF TAGGED ARCHITECTURE. Feustel, E. A. (Rice Univ., Houston, Tex. (USA). Lab. for Computer Science and Engineering). 1 Jul 1972. Contract AT(40-1)-4061. 56p. Dep. NTIS $6.00.

It is proposed that all data elements in a computer memory be self-representing. Each element is tagged directly or the access path to the element gives an effective indirect tag. The advantages of the change from the traditional von Neumann machine to the tagged architecture propagate through all software areas including programming systems, operating systems, debugging systems, and instrumentation. The advantages which accrue to the hardware designer are also discussed and examples are given in both large scale computers and minicomputers. A simple implementation is briefly discussed and some of the economic issues are briefly examined. Because of these advantages we conclude that the tagged architecture should replace the von Neumann architecture in many instances. (auth)

26147 (ORO-4061-6) INTRODUCTION TO THE IMPLEMENTATION LANGUAGE NEW. Warren, S. K. (Rice Univ., Houston, Tex. (USA)). Apr 1972. Contract AT(40-1)-4061. 106p. Dep. NTIS $8.50.

26148 (ORO-4061-8) EXPERIENCE WITH THE IMPLEMENTATION LANGUAGE: NEW/1. Feustel, E. A.; Warren, S. K.; Donegan, M. K.; Shields, T. E. (Rice Univ., Houston, Tex. (USA). Lab. for Computer Science and Engineering). Feb 1973. Contract AT(40-1)-4061. 33p. Dep. NTIS $4.75.

The attempted implementation of BCPL on a tagged architecture is described. It indicates why BCPL and conventional system programming languages were found to be unsatisfactory for tagged architectures. It describes the design process for a system programming language for a tagged architecture that is machine oriented. The language NEW/1 is described and an annotated example is provided. (auth)

26149 (RT/EDP-(74)2) PLOTTING AND COMPENSATION OF ROOT LOCUS BY A DIGITAL COMPUTER. Bernabei, R.; Ferri, S. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb 1974. 76p. (In Italian). Dep. NTIS (U. S. Sales Only) $7.00.

26150 (RT/FI-(74)4) HINZ AND GURLAND TEST: APPLICATIONS TO P-M-Z-B-B DISTRIBUTION. Pacilio, N.; Jorio, V. M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jan 1974. 50p. (In Italian). Dep. NTIS (US Sales Only) $5.50.

The Hinz and Gurland indicators, namely cumulants of probability ratios, are highly effective parameters for describing the nature of a distribution under analysis. A graphical procedure based on these parameters helps to choose the best-fitting distribution among those known in the statistical literature. An extensive set of P-M-Z-B-B distributions is analyzed in correlation conditions that range from very small to very large. The latter situation is strongly outside the negative binomial distribution approximation but features interesting regularities. They could mean that the P-M-Z-B-B distribution might be approximated by a simpler and more compact generating function. (auth)

26151 (SAND-74-0046) SWSLOT: A PROGRAM FOR CALCULATING THE CHARACTERISTICS OF SLOT AND SANDWICH SLOT TRANSMISSION LINES. Moyer, R. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 18p. Dep. NTIS $4.00.

A Fortran IV program entitled SWSLOT is used to calculate slot and sandwich slot transmission line characteristics. Quantities computed are: characteristic impedance, ratio of free-space wavelength to slot line wavelength, and the ratio of phase velocity to group velocity. Input parameters are: substrate thicknesses, dielectric constants, frequency, slot-width values desired, and electric wall separation. (auth)

26152 (SAND-74-0058) USING DE/STEP, INTRP TO SOLVE ORDINARY DIFFERENTIAL EQUATIONS. Shampine, L. F.; Gordon, M. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 37p. Dep. NTIS $5.00.

The implementation of the codes DE/STEP and INTRP on various computing systems and how to use these codes to solve ordinary differential equations are described. Some valuable extensions of the codes are cited. (JCW)

26153 (SAND-74-8200) PSMTH AND SMTHDR: ROUTINES FOR LOCAL SMOOTHING AND DERIVATIVE CALCULATION OF DATA. Huddleston, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA); Sandia Labs., Livermore, Calif. (USA)). Aug 1974. Contract AT(29-1)-789. 18p. Dep. NTIS $4.00.

Subroutine PSMTH is a computational procedure for Polynomial SMooTHing of data and for calculating derivatives from a string of data (X(I),Y(I), I = 1, ..., N. Short strings of overlapping data are used for the polynomial fits together with routines for selecting the proper degree of fit on each string. Subroutine PSMTH is an all-in-core subroutine while SMTHDR accomplishes the same task for data stored in files with moderate sacrifice in speed to achieve minimal core requirements. (auth)

26154 (SAND-74-8206) FITTING DATA WITH POLYNOMIAL SPLINES. Lathrop, J. F. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 17p. Dep. NTIS $4.00.

The user's manual describes two interactive graphics least squares curve fitting programs based on the Modified Schmidt procedure. The basis functions used to approximate the data are single variable polynomial splines. One of the programs includes the capability of specifying both equality and inequality constraints to control the form of the approximation. (auth)

26155 (SGAE-2285) AUXILIARY PROGRAMS FOR BYTE AND BIT MANIPULATIONS IN FORTRAN. Jakubczyk, G. M.; Krotz, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Forschungszentrum). May 1974. 9p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

The FORTRAN Subroutines that are written in IBM/360 assembler language and can be called by the names CONSTR, UNPPAC, PACUNP serve for byte and bit handling otherwise not possible in FORTRAN. Out of a byte string CONSTR takes a substring and places it in an output area at the user's disposal, according to the conversion mode left justified as a character string or right justified as a binary integer of at most 16 or 32 bits, respectively. Out of a bit string PACUNP takes a substring and puts it right justified in an output area; UNPPAC is the reversal of PACUNP. (tr-auth)

26156 (SLA-74-0239) USERS MANUAL FOR QMESH, A SELF-ORGANIZING MESH GENERATION PROGRAM. Jones, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 66p. Dep. NTIS $6.50.

Complete user instructions are given for the mesh generation program, QMESH, and its companion bandwidth minimizing program, RENUM. QMESH is a powerful, flexible program for producing meshes having quadrilateral elements on arbitrarily shaped two-dimensional bodies. (auth)

26157 (SLA-74-0331) BRIEF INSTRUCTIONS FOR USING THE SANDIA NUMERICAL MATHEMATICAL SUBROUTINE LIBRARY ON THE DEC PDP-10. Bailey, C. B.; Gordon, M. K.; Jones, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1974. Contract AT(29-1)-789. 96p. Dep. NTIS $8.00.

The library contains general-purpose, mathematical, computing routines for numerical quatratures and for the solution of linear algebraic equations. It supplements the computer system's library of FORTRAN functions by including special mathematical functions that are not provided in the system, such as ERF and Bessel functions. (MCW)

26158 (SLA-74-5241) USING THE SET EQUATION TRANSFORMATION SYSTEM IN FAULT TREE ANALYSIS. Worrell, R. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 33p. (CONF-740906-2). Dep. NTIS $4.75.

From conference on reliability and fault tree analysis; Berkeley, California, USA (3 Sep 1974).

The Set Equation Transformation System (SETS) is a system designed to achieve the symbolic manipulation of set equations. This type of processing constitutes a deterministic technique that is useful in fault tree analysis and other Boolean applications. The system provides a comprehensive capability for generating and processing set equations that includes the reduction of set equations by the application of set identities. The analyst invokes the various procedures available by writing a SETS user program that is then executed by the computer. Thus, the analyst controls what processing is to take place, and thereby exercises a flexibility of the system that is quite useful when dealing with large equations. Example SETS user programs have been included to illustrate the use of this system in fault tree analysis. (auth)

26159 (UCID-1502(Rev. 1)) COMPUTER ANALYSIS AND DESIGN OF ELECTRONIC CIRCUITS (PROGRAMS AVAILABLE TO LRL DESIGN ENGINEERS). Magnuson, W. G. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Oct 1970. 7p. Dep. NTIS $4.00.

The BIAS program solves for the dc node-to-datum voltages and transistor operating points of circuits containing resistors, bipolar (NPN or PNP) transistors, current sources, and grounded voltage sources. The analysis techniques of the CALAHAN program uses a matrix algebra approach to find network trees allowing transfer functions to be found and may contain resistors, capacitors, inductors, and voltage-controlled current sources. CIRCUS provides the electronic circuit for obtaining both the steady-state and transient solution for networks containing bipolar and field-effect transistors, conventional, tunnel, and zener diodes, and 4-region devices. CORNAP allows analysis of a network with two-terminal passive circuit elements — resistance, inductance, and capacitance, mutual inductance and capacitance, and the four two-terminal controlled sources — voltage/current controlled voltage/current sources. ECAP reads and interprets the input cards and transfers to one of three options: ac, dc, or transient analysis. SCEPTRE is the System for Circuit Evaluation and Prediction of Transient Radiation Effects developed to investigate the effects of radiation on semiconductors. (MCW)

26160 (UCID-15358) NEW SET OF DISPLAY SUBROUTINES FOR THE IBM 7094-DD80A SYSTEM. Bertran, R.; Cecil, A.; Cralle, R.; Michael, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Mar 1967. Contract W-7405-eng-48. 26p. Dep. NTIS $4.50.

A set of subroutines was developed for the general activity of graphic communication. They were used to supplement graphic data processing, on-line (dynamic) control, Eyeball control, and microfilm recording. (MCW)

26161 (UCID-15394) APPLICATION OF A DIGITAL COMPUTER TO THE CONTROL OF THERMAL TESTING CHAMBERS. Sykes, R. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1968. Contract W-7405-eng-48. 60p. Dep. NTIS $6.00.

A feasibility study was conducted to determine the desirability of controlling several thermal testing chambers by means of a general purpose digital computer. The results indicate that such a system would be very desirable from a technical point of view. By means of simulation, it was shown that computerized control, using sampling periods in the range of 60 seconds, was as effective in controlling temperature, if not more so, as the existing analog system. Also, since sampling periods of this order would require only a very small amount of the computer's time, control of this nature would be performed as a secondary function, leaving the computer virtually free to perform its primary responsibility. (auth)

26162 (UCID-15557) FINITE DIFFERENCE EQUATIONS FOR CHERRY-PIE HYDRODYNAMICS IN ONE SPACE DIMENSION. Crowley, W. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Oct 1969. 24p. Dep. NTIS $4.25.

26163 (UCRL-51581) DIRECT SOLUTION OF THE SPHERICAL-HARMONICS APPROXIMATION TO THE TRANSFER EQUATION FOR A PLANE-PARALLEL, NONHOMOGENEOUS ATMOSPHERE. Dave, J. V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Jun 1974. 49p. Dep. NTIS $4.00.

The method of obtaining a direct solution of the spherical harmonics approximation to the equation of radiative transfer was shown to be a very efficient and powerful one for the evaluation of diffuse fluxes at various levels of a plane-parallel, nonhomogeneous atmosphere containing arbitrary height distributions of absorbing gases, aerosol particles, and cloud water drops. An attempt is made to provide (a) a detailed derivation of the spherical harmonics equations starting with the basic transfer equation, and (b) a description of the method for the numerical solution of the resultant system of linear equations. To be consistent with the other published work, the zenith angle relative to the negative normal-optical-thickness axis was measured. To provide a full treatment of the planetary radiation problem, earlier derivations were extended to include isotropic illumination of the atmosphere from below. (auth)

26164 (UCRL-75667(Rev.1)) MODEL HIGHLIGHTING THE SECURITY OF OPERATING SYSTEMS. Conn, R. W.; Yamamoto, R. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jul 1974. 8p. (CONF-741101-1). Dep. NTIS $4.00.

From ACM annual conference; San Diego, California, USA (11 Nov 1974).

The major thrust toward providing secure computing facilities has gone into the design of, or models for, new operating systems. Work directed toward securing current systems has, for the most part, taken the form of penetration attempts. Penetration efforts have led several authors to identify generic weaknesses, but grouping by weakness has not led to formal methods. An approach showing greater promise in identifying trouble spots, as well as characterizing existing operating systems in a more general sense, lies in forming graph models in which nodes are program modules or data structures, and arcs are access or shared resource synchronization paths. A given system should be capable of reduction to a graph of this sort by appropriate analysis of its load modules. (auth)

26165 (USC-113P-59) DYNAMIC PROGRAMMING AND BRACHISTOCHRONE PROBLEMS IN ABSTRACT SPACES. Technical Report No. RB73-28. Bellman, R. (University of Southern California, Los Angeles (USA)). Jul 1973. Contract AT(04-3)-113. 17p. Dep. NTIS $4.00.

Dynamic programming was used to provide analytic and computational treatments of the classical problem and some natural extensions were cited. With the assumption of two points in space, the path is found that a particle, under the influence of gravity but without friction, will slide in minimum time. Methods of dynamic programming are used to show generalized brachistochrone problems in abstract spaces. Simplifications and computational results are indicated. Natural extensions in medical diagnosis, game-playing, and chemotherapy are described. (MCW)

26166 (WAPD-TM-1175) IMPLEMENTATION OF ECS FILE SWITCHING BETWEEN CDC 6000/7000 SERIES COMPUTERS. Marinacci, J. W. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). May 1974. Contract AT(36-1)-GEN-14. 20p. Dep. NTIS $4.00.

Approximately one million 60-bit words of Extended Core Storage (ECS) are shared between two CDC 6600 computers and one CDC 7600 computer at the Bettis Atomic Power Laboratory. Initially, ECS was used as a stand-alone, user-program-driven peripheral device, but it soon became apparent that its speed, capacity, and multi-mainframe access capabilities made it an extremely useful device for a number of operating system applications. This paper describes one such application, namely interconnecting the three computers into a network using ECS as the medium for data transfer. (auth)

Miscellaneous

26167 (BNL-18952) SPECTRA OF ATMOSPHERIC TURBULENCE OVER THE SEA DURING STABLY STRATIFIED CONDI-

TIONS. SethuRaman, S.; Brown, R. M.; Tichler, J. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 6p. (CONF-740922-9). Dep. NTIS $4.00.

From symposium on atmospheric diffusion and air pollution; Santa Barbara, California, USA (9 Sep 1974).

Over-water turbulence intensities are found to be 50 to 100 per cent less than those over land for the same stability conditions. Longitudinal and vertical wind speed spectra show the existence of Kolmogoroff's universal form at high wave numbers. Comparison of over-water to over-land spectra indicates a frequency shift towards lower values for the vertical component of wind speed and an amplitude shift towards higher values for the longitudinal component. The ratio σ_w/u, was found to have an average value of 1.16 for moderately stable flow conditions. The Lagrangian statistical parameters could be predicted from Eulerian turbulence measurements with reasonable success. (auth)

26168 (CONF-740912-1) REGIONAL ENVIRONMENTAL SYSTEMS ANALYSIS: AN APPROACH FOR MANAGEMENT. McCarthy, M. M.; Durfee, R. C.; Newman, M. L.; Yaffee, S. L.; Betson, R.; Craven, C. W. Jr.; Cox, T. L.; Holbrook, J.; Huff, D. D.; Strand, R. (Oak Ridge National Lab., Tenn. (USA)). 1974. 6p. Dep. NTIS $4.00.

From 1st international congress of ecology; The Hague, Netherlands (8 Sep 1974).

Procedures developed for the evaluation of environmental consequences of spatially distributed activities are documented. The strategy was to develop integrated analyses of cultural and natural systems. The research is directed toward a 7,000-square-mile, 16-county urban/rural region in the southeastern quarter of the United States centered on Knoxville, Tennessee. An important aspect of this research is the ability to interrelate and to show the cumulative effects of different changes to the environment. The decision maker can begin to interact with the system and see the results of different management decisions. (auth)

26169 (COO-3292-11) TRACE METALS AND INTERSTITIAL WATER CHEMISTRY OF BACK RIVER, MARYLAND. Bricker, O. P.; Ferguson, J. F.; Huggett, R. J. (Johns Hopkins Univ., Baltimore, Md. (USA); Virginia Inst. of Marine Science, Gloucester Point (USA)). Jul 1974. Contract AT(11-1)-3292. 5p. (CONF-741007-1). Dep. NTIS $4.00.

From 47th annual conference on the water pollution control federation; Denver, Colorado, USA (6 Oct 1974).

The Back River Sewage Treatment Plant is evidently the source for the metals in the sediments examined from the estuary of the Chesapeake Bay. High concentrations of Zn, Cu, Pb, and Cd were found in the upper 1 cm/layer of the sediments. Analyses of eight cores show that the concentrations of Zn, Cu, Pb, Cd, Ni, Cr, and Co in both HNO_3 and HCl extracts and organic matter as carbon and nitrogen decline at depths between 40 and 60 cm. The analyses for Fe, Pb NH_3, alkalinity, Cl^-, sulfide, Pt electrode potential, and pH are made. Benthic organisms were sampled. (MCW)

26170 (ORNL-NSF-EP-74) REGIONAL ENVIRONMENTAL SYSTEMS ANALYSIS PROGRAM. Progress Report, June 1973–June 1974. Craven, C. W. Jr.; McCarthy, M. M.; Olsen, R. J.; Schuller, C. R.; Voelker, A. H. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 139p. Dep. NTIS $10.00.

Research strategy and unifying functions of regional analysis, the required mechanisms for merging disciplinary studies, are reported. Progress is reported in the following sections: Regional Environmental Systems Analysis; Socioeconomic Analysis; Land-Use Analysis; Natural Systems Analysis; and the Policy Analysis and Social Impacts. Publications of the Regional Environmental Systems Analysis Program are listed. (MCW)

26171 (SLA-74-5286) BALLOON GONDOLA MEASUREMENTS. Herrington, P. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 6p. (CONF-740914-1). Dep. NTIS $4.00.

From 8th AFCRL scientific balloon symposium; Hyannis, Massachusetts, USA (30 Sep 1974).

Measurements of gondola attitude were made during a stratospheric balloon flight on September 18, 1972 to provide support data for the scientific instruments on board. Data were obtained from the instruments continuously for one hour during sunrise and eighteen short periods. Measuring methods for spin rate, frame temperature, and levelness are described. (auth)

Chemistry

26172 (BDX-613-1200) CONTAMINANT REMOVAL USING SOLUBILITY PARAMETER TECHNOLOGY. Jackson, L. C. (Bendix Corp., Kansas City, Mo. (USA)). [nd]. Contract AT (29-1)-613. 7p. (CONF-740818-1). Dep. NTIS $4.00.

From 1st national adhesive bonded metal structures conference; New York, New York, USA (14 Aug 1974).

26173 (CEA-CONF-2556) DETERMINATION OF LOW CONCENTRATION OF ORGANIC AND INORGANIC MERCURY BY GASEOUS CHROMATOGRAPHY. Batti, R.; Magnaval, R.; Lamy, G.; Lafuma, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). 1973. 11p. (In French). (CONF-730743-1). Dep. NTIS (US Sales Only) $4.00.

From European colloquium on the problems posed by the contamination of man and his environment by mercury and cadmium; Luxembourg,(3 Jul 1973).

A method for the determination of methylmercury by gas chromatography is proposed. The method involves the separation of methylmercury from its matrix by concentrated HCl and subsequent extraction of methylmercury chloride in benzene. After purification an aliquot of the benzene phase is injected into a gas chromatographic column consisting of 5% cyclohexanedimethanol succinate held on Chrom.W(H P). The method is extended to the analysis of the inorganic fraction (Hg^{2+}) that is converted into phenylmercury chloride by using sodium benzenesulfinate and is determined in the same way. The method is quantitative down to 0.05 ppM and the procedure is proposed for the determination of the organic and inorganic fraction in sediments and biological material. (auth)

26174 (CONF-740917-4) HYDRODYNAMICS BEHAVIOR OF PACKED LIQUID–LIQUID EXTRACTION COLUMNS WITH FLUIDS OF DIFFERENT DENSITIES. Watson, J. S.; McNeese, L. E. (Oak Ridge National Lab., Tenn. (USA)). 1974. 20p. Dep. NTIS $4.00.

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Measurements of dispersed phase holdup, pressure drop, axial dispersion, and flooding rates in packed columns are reported for a variety of packing materials and fluid properties. Correlations for predicting column performance that are applicable over a wide range of fluid properties are examined. (auth)

26175 (IS-M-19) CHEMICAL SYNTHESIS OF METAL RICH TANTALUM SULFIDES AT HIGH PRESSURES AND HIGH TEMPERATURES. Muhle, M. E.; Bautista, R. G. (Ames Lab., Iowa (USA)). 1974. 8p. (CONF-740919-1). Dep. NTIS $4.00.

From Joint AICHE-VTG meeting; Munich, F.R. Germany (17 Sep 1974).

The synthesis of three new tantalum rich-sulfur compounds, Ta_7S_3, Ta_7S and Ta_3S, has been accomplished by the application of high pressures and high temperatures. These are very hard and brittle and appear to have conducting properties. (auth)

26176 (ITF-73-170P) FREE ENERGY AND SCREENING POTENTIALS OF MIXED ION-WATER SYSTEM. Golovko, M. F.; Gabashi, M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 38p. (In Russian). Dep. NTIS (U. S. Sales Only) $5.00.

The configurational integral of mixed ion-water systems is calculated. The special electrostatic model stimulating the formation of hydrogen bonds for long-range part of ion-molecular and intermolecular interactions is chosen. The common cluster decomposition of the free energy of the system is obtained by the collective variable method. The effects of screening and the accountment of orientations are discussed. (tr-auth)

26177 (LBL-2518) REACTOR DESIGNS FOR THE CHEMICAL VAPOR DEPOSITION OF EPITAXIAL $GaAs_{1-x}P_x$. Shaikh, S. A.; Donaghey, L. F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. Contract W-7405-eng-48. 30p. (CONF-740810-1). Dep. NTIS $4.50.

From 3rd international symposium on chemical reaction engineering; Evanston, Illinois, USA (27 Aug 1974).

Research and commercial reactor designs for the chemical vapor deposition of $GaAs_{1-x}P_x$ alloys are reviewed. Chemical reaction schemes and reactor designs are surveyed for reactor design criteria and limitations for open flow reactors utilizing alternative source chemicals. Commercial reactor design is examined in terms of flow orientation, source chemicals, and substrate orientation. The design and operating properties of a cold wall reactor utilizing trimethylgallium as a source chemical is examined in detail and compared to hot wall reactor properties. (auth)

26178 (LBL-2701) LARGE AMPLITUDE MOTION IN MOLECULES. Bernstein, L. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 238p. Dep. NTIS $15.00.

Thesis.

A pseudo Jahn–Teller formalism is used to construct potential functions for molecules with large amplitude internal motions. The types of molecules studied are MX_3 (C_{3v}, inversion), MX_5 (D_{3h}, axial-equatorial interchange), XeF_6 (distorted O_h, pseudorotation), MX_7 (distorted D_{5h}, pseudorotation), and four-membered, pseudo

four-membered, and five-membered rings (ring puckering). The forms of the potential functions for each of the molecules are shown and the behavior of these molecules in inhomogeneous electric fields is discussed. (MCW)

26179 (LBL-2913) USE OF THERMALLY SENSITIVE ION-EXCHANGE RESINS OR ELECTRICALLY SENSITIVE LIQUID CRYSTALS AS ADSORBENTS. Latty, J. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1974. Contract W-7405-eng-48. 170p. Dep. NTIS $11.50.

Thesis.

The desalting of aqueous solutions was described as experimentally accomplished by thermally cycling a fixed bed of weak-acid and weak-base ion-exchange resins. A rate control model was proposed that accounts for the observed properties of the mixed resin system. Using this model, several processes were proposed and evaluated for eventual application to large scale brackish water desalting. The work on cyclic sorption allows experimental observations of sorption properties of randomly oriented, nematic liquid crystal mesophases when subjected to a 3000 gauss magnetic field or a 1000 to 7800 volt per centimeter, D.C. electric field. These experimental observations are evaluated in light of published data for similar systems. (auth)

26180 (ORNL-TM-4669) QUANTITATIVE X-RAY PHOTOELECTRON SPECTROSCOPY AND APPLICATIONS TO AIR POLLUTION. Carter, W. J. III. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 137p. Dep. NTIS (U. S. Sales Only) $9.50.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

A simple model was proposed for use in the quantitative x-ray photoelectron spectroscopy of solids. It involved two basic parameters for obtaining relative elemental analysis: the photoelectron cross section for ionization and the mean free path of the photoejected electron. Experimental data designed to test the model were obtained on a 180° double-focusing spherical-sector electrostatic spectrometer. The relative intensities for nine pure compounds examined in the gaseous state by Mg K_α radiation were determined in order to assess the value of the cross-sections. Approximately 15 pure solids were studied by both Mg K_α and Al K_α photon sources in order to obtain an evaluation of the overall theory. The analytical usefullness of XPS was applied for studying three particulate air pollution samples and the filter paper on which they were collected by using Al K_α excitation. (MCW)

26181 (ORNL-tr-2850) TRIMERIC Na AND K DIFLUORO-ORTHOBORATES. Ryss, I. G. Translated by M. Gerrard from Dokl. Akad. Nauk SSSR; 97: No. 4, 691-693(1954). 3p. Dep. NTIS $4.00.

The synthesis of $Na_3B_3O_3F_6$ and the composition of the sample are described. The compound apparently contains the 6-member boron-oxygen ring, and may be considered as a boroxol, $B_3O_3H_3$ in which the hydrogen has been replaced by fluorine. Reactions of a saturated solution of $Na_3B_3O_3F_6$ with a saturated solution of KI are discussed. (MCW)

26182 (ORO-4535-1) SOLVENT EXTRACTION STUDIES USING HIGH-MOLECULAR-WEIGHT AMINES. Progress Report. McDonald, C. (Texas Southern Univ., Houston (USA)). 19 Jul 1974. Contract AT(40-1)-4535. 18p. Dep. NTIS $4.00.

The feasibility of using high-molecular-weight amines for the extraction of metals from aqueous solutions was investigated for the application by large industries for economical removal of toxic metal ions from their waste water. The extraction of zinc in chloride and bromide media and cadmium from chloride media using Aliquat 336-S is described. Progress is reported on studies of zinc chloride and cadmium chloride-Aliquat 336-S systems. Studies are in progress or planned for mercury and lead extraction in aqueous solutions using high-molecular-weight amines. (MCW)

26183 (SLA-74-5351) APPLICATION OF SURFACE AND VOLUME SENSITIVE ANALYTICAL TECHNIQUES TO MICRO-PARTICLE CHEMICAL ANALYSIS. Jellison, J. L.; Holloway, P. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 36p. (CONF-740812-2). Dep. NTIS $5.00.

From 7th annual international Metallographic Society technical conference; Gatlinburg, Tennessee, USA (4 Aug 1974).

The silver frit terminations of barium titanate brick capacitors were examined by x-ray, electron, and mass analysis to identify contaminants that might play a role in the corrosion of aluminum-to-silver ultrasonic bonds. These analyses identified the contaminants and allowed a comparison of the attributes and limitations of several different analytic techniques. Topographic features were examined in a SEM while x-ray fluorescence analysis was performed by energy dispersive analysis in a SEM and by both energy and wavelength dispersive analysis in an electron microprobe. Electron diffraction was performed in a TEM. Auger electron spectroscopy and ion microprobe mass spectrometry were used for analyzing the surface chemical composition. Chlorine and silver chloride were identified on the terminations. For analysis of microparticles, the lateral resolution, detected depth, and elemental sensitivity of a particular analytic technique are very important. These properties are compared for the five techniques and the techniques complemented each other. (auth)

26184 (UCID-15444) RAPID DETERMINATION OF TRIS (CHLOROETHYLPHOSPHATE) IN PBX-9404 EXPLOSIVE. Crossman, G. L.; Selig, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Feb 1969. 7p. Dep. NTIS $4.00.

A rapid method for determining the tris(chloroethylphosphate) (CEF) in PBX-9404 explosive is given. After combustion in an oxygen bomb, the chloride is titrated potentiometrically with standard silver nitrate. A chloride ion indicating electrode and a calomel reference electrode are used. A single determination can be performed in 30 min. (auth)

26185 (UCID-15462) ANALYSIS OF BIS(2,2-DINITRO-2-FLUOROETHYL) FORMAL (FEFO) IN LX-09-0. Selig, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Feb 1969. 10p. Dep. NTIS $4.00.

A method for the analysis of bis(2,2-dinitro-2-fluoroethyl) formal (FEFO) in the explosive LX-09-0 is discussed. After combustion in an oxygen bomb, fluoride is titrated potentiometrically with standard lanthanum(III) solution. A fluoride ion indicating electrode and a calomel reference electrode are used in conjunction with an expanded-scale pH meter. (auth)

26186 (UCID-15480) ANALYSIS OF WATER, HYDROXYL GROUP CONCENTRATION, AND CONCENTRATION OF CYCLIC IMPURITIES IN HYDROXY-TERMINATED POLYDIMETHYLSILOXANE FLUIDS. Bissell, E. R.; Fields, D. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1969. 13p. Dep. NTIS $4.00.

Water and hydroxyl concentrations in hydroxy-terminated polydimethylsiloxane fluids are measured by determining the products of reaction with bis(trimethylsilyl)-trifluoroacetamide by means of gas chromatography. Cyclic polydimethylsiloxane impurities are determined simultaneously. Water can be determined to ±0.01%. At concentrations less than 0.5%, hydroxyl can be determined to ±0.02% and, in the range from about 1 to 3%, to about ±0.1%. Cyclics in concentrations less than 1% can be determined to ±0.01% or better. (auth)

26187 (UCID-15648(Rev. 1)) REAL-TIME COMPUTER PREDICTION OF ENDPOINTS IN CONTROLLED-POTENTIAL COULOMETRY. Supplementary Information on the Digital and Analog Systems. Stephens, F. B.; Jakob, F.; Rigdon, L. P.; Harrar, J. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Oct 1971. 22p. Dep. NTIS $4.25.

26188 (UCID-15667) THERMAL DECOMPOSITION OF PBX-9404 AS A FUNCTION OF TIME AND TEMPERATURE. Walker, F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Jun 1970. 7p. Dep. NTIS $4.00.

Several studies were made of the thermal stability of a plastic-bonded explosive PBX-9404. Data from these studies were reviewed and related through the use of a computer calculated multiple regression analysis. Two graphs are presented that can be used to determine the gas evolution rate or the stockpile life of PBX-9404 as a function of temperature. (auth)

26189 (UCRL-75582) RESEARCH ON THE FLUORESCENCE OF RARE EARTH β-DIKETONES. Mode, V. A.; Sisson, D. H.; McMillan, G. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Jun 1974. 7p. (CONF-741002-6). Dep. NTIS $4.00.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

26190 (UCRL-75801) EFFECT OF NO_x EFFLUENTS ON OZONE. Chang, J. S.; Johnston, H. S. (California Univ., Livermore Lab.). Jun 1974. 28p. (CONF-740232-1). Dep. NTIS $4.50.

From 3rd conference on CIAP; Boston, Massachusetts, USA (26 Feb 1974).

Model calculations on the reduction of stratospheric ozone by nitrogen oxides from supersonic transport exhausts were carried out from 1971–1974. The results of these model calculations are assembled. The spread in calculated reductions of ozone for a given rate of input of nitrogen oxides is about a factor of ten. Some of this spread in results can be identified in terms of differences in the chemistry of the models. However, the greatest source of discrepancy appears to be from different models of eddy diffusion and boundary conditions. Eight models show a surprisingly close agreement when expressed in terms of percentage ozone reduction as a function of percentage increase in the NO_x

column; doubling stratospheric NO_x is calculated to reduce ozone by 20 percent. (auth)

Life Sciences

26191 (BNL-18951) MEASURED EFFECT OF SHEAR ON PLUME DISPERSION. Brown, R. M.; Michael, P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 6p. (CONF-740922-1). Dep. NTIS $4.00.

From symposium on atmospheric diffusion and air pollution; Santa Barbara, California, USA (9 Sep 1974).

Multiple plume traversing was studied by aerial measurements at the Long Island Lighting Company's electric power generating plant. It has three 183-m stacks located 60 m apart and the plumes merge within 1 m downwind. Data analyses indicate that for point source releases from tall stacks, the crosswind standard deviations were found to be greater during stable conditions than during neutral conditions. This is due to larger wind shears associated with increased stability. It is the dominant factor in plume dispersion at great distances downwind during stable conditions. (MCW)

26192 (BNL-19003) HETEROGENEOUS ASSOCIATIONS OF CELLS FORMED IN VITRO. Carlson, P. S.; Chaleff, R. S. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 17p. (CONF-740817-1). Dep. NTIS $4.00.

From conference on genetic manipulations with plant materials; Liege, Belgium (4 Aug 1974).

The ability to culture somatic cells of higher plants under defined conditions permits direct selection for variants among large cell populations. Cells of tobacco resistant to the methionine analogue, methionine sulfoximine, were selected in vitro and regenerated into mature plants. All three tobacco mutants are resistant to infection by Pseudomonas tabaci, the agent that causes wildfire disease. Two of these mutants contain elevated intracellular levels of free methionine. Analogue resistance also has been used to select for variant rice cell lines that have increased levels of certain free amino acids and higher relative amounts of lysine incorporated into protein. An experimental system also is described for forcing a symbiotic association between cultured cells of carrot and the free-living nitrogen-fixing bacterium, Azotobacter vinelandii. The composite callus grows slowly on a defined medium lacking combined nitrogen. (auth)

26193 (BNL-19027) HIGHER PLANT CELLS AS EXPERIMENTAL ORGANISMS. Chaleff, R. S.; Carlson, P. S. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 31p. (CONF-740720-1). Dep. NTIS $4.75.

From 2nd John Innes symposium: modification of the information content in plant cells; Norwich, UK (16 Jul 1974).

Two experimental systems are described which explore the applicability of in vitro cultures to force associations between cells of widely divergent origins. In one experiment, chimeral plants were induced to differentiate from mixed calluses formed by coculturing cells of two tobacco species. In another experiment, a symbiosis was forced between cells of carrot and of the free-living nitrogen-fixing bacterium, Azotobacter vinelandii. (auth)

26194 (BNL-19052) IN VITRO SELECTION FOR MUTANTS OF HIGHER PLANTS. Chaleff, R. S.; Carlson, P. S. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 13p. (CONF-740817-2). Dep. NTIS $4.00.

From conference on genetic manipulations with plant materials; Liege, Belgium (4 Aug 1974).

Tobacco plants resistant to wildfire disease were regenerated from methionine sulfoximine-resistant calluses selected in vitro. The intracellular concentration of free methionine is elevated in two of the three mutant plants. Three rice cell lines which are resistant to the lysine analogue, S-(β-aminoethyl)-cysteine have also been isolated in vitro. Analyses of free and protein-incorporated amino acid composition reveal increased levels of several amino acids in the variant cell lines. (auth)

26195 (BNL-19053) PANCREATIC EXOCRINE SECRETORY PROTEINS. Greene, L. J. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 8p. (CONF-740551-1). Dep. NTIS $4.00.

From planning committee for pancreatic cancer; New Orleans, Louisiana, USA (15 May 1974).

26196 (CEA-CONF-2557) INTESTINAL ABSORPTION OF CADMIUM AND MERCURY. Karhausen, L. R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). [nd]. 28p. (In French). (CONF-730743-2). Dep. NTIS (US Sales Only) $4.50.

From European colloquium on the problems posed by the contamination of man and his environment by mercury and cadmium; Luxembourg (3 Jul 1973).

26197 (CONF-740648-4) MULTIFACTORIAL RESPIRATORY CARCINOGENESIS. Nettesheim, P. (Oak Ridge National Lab., Tenn. (USA)). 1974. 10p. Dep. NTIS $4.00.

From symposium on experimental respiratory carcinogenesis and bioassays; Seattle, Washington, USA (23 Jun 1974).

26198 (CONF-740924-1) FUNDAMENTAL ASPECTS OF FREEZING INJURY IN LIVING CELLS. Mazur, P. (Oak Ridge National Lab., Tenn. (USA)). 1974. 16p. Dep. NTIS $4.00.

From 11th international congress for microbiology and 1st intersectional congress of the International Association of Microbiological Societies; Tokyo, Japan (1 Sep 1974).

26199 (COO-1300-38) ORGANIZATION OF THE R CHROMOSOME REGION IN MAIZE. Progress Report, July 1, 1973–August 31, 1974. Kermicle, J. L. (Wisconsin Univ., Madison (USA)). 1974. Contract AT(11-1)-1300. 11p. Dep. NTIS $4.00.

26200 (COO-1329-25) POPULATION DYNAMICS, MOVEMENT, AND HOME RANGE OF BLACK-TAILED JACKRABBITS (LEPUS CALIFORNICUS) IN CURLEW VALLEY, NORTHERN UTAH. Progress Report, July 1, 1973–June 30, 1974. Stoddart, L. C. (Utah State Univ., Logan (USA). Dept. of Wildlife Science). 1974. Contract AT(11-1)-1329. 26p. Dep. NTIS $4.50.

26201 (COO-1332-97) RELEVANCE OF HOME RANGE CONCEPTS TO GAME BIOLOGY. Tester, J. R.; Siniff, D. B. (Minnesota Univ., Minneapolis (USA)). 1973. 19p. (CONF-7309116-1). Dep. NTIS $4.00.

From 11th international congress of game biologists meeting; Stockholm, Sweden (Sep 1973).

26202 (COO-2002-23) ENERGETICS OF NATURAL POPULATIONS OF FRESHWATER MACROCONSUMERS. Progress Report, September 1, 1969–September 30, 1974. Cummins, K. W. (Michigan State Univ., East Lansing (USA)). 1974. Contract AT(11-1)-2002. 10p. Dep. NTIS $4.00.

The research encompassed two main phases: 1) the determination of energetic parameters for populations of selected macroinvertebrates, particularly Leptodora kindtii (Crustacea : Cladocera) and Glossosoma nigrior (Insects : Trichoptera) and, 2) the assessment of the functional roles played by important macroinvertebrates of stream benthic communities. Respiration energy expenditure was shown to be as high as 90% in predator populations and 70 to 80% in herbivore-detritivore populations. For herbivores with two generations per year production was similar between generations and between years. Based on a large number of caloric determinations of many species of macroinvertebrates, an average value of 5.5 Kcal/ash-free gram was estimated to be suitable for most energy budget determinations. It was shown that the macroinvertebrates of running waters can be usefully partitioned into shredders (large particle detritivores), collectors (fine particle detritivores), scrapers (periphytic algal grazers), and predators. The shredders account for approximately 20 to 24% of the processing of leaf litter to CO_2, animal biomass, and fine particles and measured feeding rates of collectors indicate they have a significant effect upon the fine particles (approximately <4 mm). (auth)

26203 (COO-2011-7) METHOD FOR THE DETERMINATION OF REGIONAL BLOOD FLOW IN TISSUES BY MEANS OF STIMULATED X-RAY FLUORESCENCE. Final Report, January 1, 1969–August 31, 1973. Ter-Pogossian, M. M. (Washington Univ., St. Louis, Mo. (USA)). 1974. Contract AT(11-1)-2011. 9p. Dep. NTIS $4.00.

Instrumentation and methodology were developed to measure the regional cerebral blood flow (rCBF) and regional cerebral blood volume (rCBV) in vivo by stimulated x-ray fluorescence. This method consisted of injecting an iodinated radiographic contrast material into the bloodstream of the subject to be studied and then passing a narrow collimated beam of x-rays through a selected region of the brain. This beam excited or fluoresced the iodinated contrast material and the resulting fluorescent x-rays were detected by an externally placed x-ray detector. The intensity of the fluorescent x-rays was used to regionally determine the amount of blood per volume of brain tissue (rCBV) and the change of this parameter with time (rCBF). This method was validated with phantom and animal studies by comparisons to more conventional in vitro techniques and was found to have an accuracy of about ±4% in the measure of rCBV and rCBF in rhesus monkeys, and ±10% in human subjects. This method was used to make the first absolute measurements of rCBV in living subjects. The method was also used to evaluate the role of cerebral blood volume in the regulation and control of cerebral blood flow in normal subjects, selected patients with cerebral pathology, and animal studies in which cerebral hemodynamic and metabolic changes were induced. (auth)

26204 (COO-2223-15) SPIN-LABELED MEMBRANES. Progress Report. Keith, A. D. (Pennsylvania State Univ., University Park (USA). Dept. of Biophysics). Jul 1974. 9p. Dep. NTIS $4.00.

26205 (COO-3012-30) QUANTITATIVE ABSORPTION OF UNDESIRED (BLOOD GROUP) ANTIBODIES FROM ANTISERA TO CEA. Reif, A. E.; Robinson, C. M. (Boston City Hospital, Mass. (USA); Tufts Univ., Boston, Mass. (USA). School of Medicine). 1974. Contract AT(11-1)-3012. 13p. Dep. NTIS $4.00.

26206 (COO-3572-3) STUDIES ON A CLASS OF HIGHLY LIPOPHILIC MEMBRANE PEPTIDES FROM MYCOPLASMA LAIDLAWII. Final Report, January 1973–March 1974. Morowitz, H. J. (Yale Univ., New Haven, Conn. (USA)). 1974. Contract AT(11-1)-3572. 4p. Dep. NTIS $4.00.

The characterization of the lipophilic membrane peptides of Mycoplasma laidlawii (Acholeplasma laidlawii) was completed. About 4% of the membrane protein extracted with the lipids consisted of peptide material difficult to isolate from the lipids. These peptides have a molecular weight between 500 and 1500 according to G-50 F Sephadex size determinations. The synthesis and location of these materials in the membrane was studied. (auth)

26207 (EDFB-IBP-74-3) REFORMATTING FOREST SURVEY TREE DETAIL DATA AT ORNL INCLUDING A DOCUMENTATION OF PROGRAM REFORM. West, D.; Stephenson, R. L.; Goff, F. G.; Johnson, W. C. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 50p. Dep. NTIS $5.45.

USDA Forest Service, Continuous Forest Inventory (CFI) tree detail data have been acquired from several of the Forest Service inventory units of the eastern United States. A description of the data, the present status of the forest inventory for each unit within each Forest Service Experiment Station region, and the status of data at ORNL are given. A reformatting procedure and program which transform the data into IBP Standard Format-Forest Service Plot Tapes are documented. (auth)

26208 (FMI-41, pp 14-23) COMPUTER SIMULATION OF SMALL BLOOD VESSEL IMAGING IN MAGNIFICATION RADIOGRAPHY. Doi, K.; Rossmann, K. Mar 1974.

In semiannual report to the Atomic Energy Commission.

26209 (FMI-41, pp 43-47) CORADS (COMPUTERIZED ONCOLOGY RADIATION AND DATA SYSTEM). Griem, M. L.; Lanzl, L. H.; Clarke, P. Z.; Rosenfeld, M. Mar 1974.

In semiannual report to the Atomic Energy Commission.

26210 (FMI-41, pp 89-100) EVALUATION OF RECEIVER OPERATING CHARACTERISTIC CURVE DATA IN TERMS OF INFORMATION THEORY, WITH APPLICATIONS IN RADIOGRAPHY. Metz, C. E.; Goodenough, D. J.; Rossmann, K. Mar 1974.

In semiannual report to the Atomic Energy Commission.

26211 (FMI-41, pp 101-112) PHYTOHEMAGGLUTININ MITOGENIC PROTEINS: STRUCTURAL EVIDENCE FOR A FAMILY OF ISOMITOGENIC PROTEINS. Miller, J. B.; Noyes, C.; Heinrikson, R.; Kingdon, H. S.; Yachnin, S. Mar 1974.

In semiannual report to the Atomic Energy Commission.

26212 (FMI-41, pp 113-123) PURIFICATION AND PROPERTIES OF PHOSPHORIBOSYL PYROPHOSPHATE SYNTHETASE FROM RAT LIVER. Roth, D. G. (National Institutes of Health, Bethesda, MD); Shelton, E.; Deuel, T. F. Mar 1974.

In semiannual report to the Atomic Energy Commission.

26213 (FMI-41, pp 124-133) STABILITY AND REGULATION OF PHOSPHORIBOSYL PYROPHOSPHATE SYNTHETASE FROM RAT LIVER. Roth, D. G.; Deuel, T. F. Mar 1974.

In semiannual report to the Atomic Energy Commission.

26214 (LA-tr-73-54) INVESTIGATIONS INTO THE RELATIONSHIP BETWEEN DNA CONTENT AND FLUORESCENCE INTENSITY IN CELLS STAINED WITH FLUOROCHROMES. Haag, D. Translated from Histochemie; 36: 283-291(1973). 13p. Dep. NTIS $4.00.

For the quantitative determination of DNA in single cells, especially for measurements with flow chamber systems, fluorescence staining is frequently employed. In contrast to cytophotometric absorbancy measurements, there is an exponential instead of a linear relationship existing between the concentration of the bound fluorochrome and the intensity of fluorescence. This results in erroneously low DNA values if the DNA concentration is very high, which may be the case during mitosis and in heterochromatic cells. To determine the possible errors, scanning absorbancy measurements of Feulgen-stained interphase nuclei and mitoses of Ehrlich–Lettre ascites tumor cells were compared with microfluorometric measurements of the same object after staining with the Schiff type reagent acriflavine. The results of the measurements of mitoses demonstrate that fluorescence readings may be decreased down to 26% with respect to the true DNA content in the case of extremely dense chromatin. Analogous relationships are valid also for the fluorescence of nucleic acids stained with ethidium bromide. Since tumor cells frequently exhibit large variations of chromatin density, a deviation of the stemline may be stimulated if many heterochromatic cells are present. Therefore, the chromatin structure of a measured cell population should be taken into consideration always when deviations of DNA values are interpreted as criteria of malignancy. (auth)

26215 (LA-UR-74-1127) ROLE FOR ELECTRONICS IN ANIMAL HEALTH AND PRODUCTION. Hensley, J. C. II; Holm, D. M.; Depp, S. W.; Koelle, A. R.; Freyman, R. W. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 8p. (CONF-740916-1). Dep. NTIS $4.00.

From Western Electronic show and convention meeting; Los Angeles, California, USA (9 Sep 1974).

26216 (LBL-2694) OPTICAL STUDY OF METAL ION–NERVE INTERACTIONS. Axelrod, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 152p. Dep. NTIS $10.75.

Thesis.

Calcium ions are intimately involved in the process of nerve conduction. Obstacles to gaining information about the precise molecular mechanisms have been the minute quantities and fast transience of Ca^{+2} interaction, and Ca^{+2} spectroscopic invisibility. In order to probe the ion-nerve membrane interaction, rare-earth ions were substituted in place of Ca^{+2} in the bathing solution of garfish olfactory nerve trunk. Low concentrations of rare-earth ions maintain excitability of nerve in Ca-free solutions, and restore excitability to nerves previously bathed in solutions free of any polyvalent ions. Furthermore, two of the rare-earth ions, Eu^{+3} and Tb^{+3}, show a much enhanced fluorescence upon chemical binding. We observed the fluorescence of Eu^{+3} and Tb^{+3} as a measure of rare-earth (and by analogy, calcium) binding to nerve, both resting and firing, and subjected to treatments with various enzymes, chemical agents, and abnormal salt concentrations. The main results are: (1) Rare-earth ions bind to proteins, NADH and possibly other molecules in the nerve; (2) The total bound rare-earth ion fluorescence changes by less than 0.01% upon firing; and (3) Most of the observed binding is a slow, continual uptake of rare-earth ion, probably into the axoplasm, rate-limited by permeation through the axon membrane. A detailed discussion of the luminescence properties of rare-earth ions, a review of membrane and neuron physiology, and suggestions for the handling and dissection of garfish are included. (auth)

26217 (NYO-3406-10) IMAGE INTENSIFICATION OF A LUMINESCENT SYSTEM USED AS A CYTOCHEMICAL PROBE. Technical Report No. 6. Calleja, G. B.; Reynolds, G. T. (Princeton Univ., N. J. (USA)). 25 Oct 1968. Contract AT(30-1)-3406. 39p. Dep. NTIS $5.00.

Single cells were isolated from the semitendinosus muscle of Rana pipiens or from the flexor muscle of the walking legs of Carcinus maenas, Callinectes sp., and Libinia emarginata. Firefly lantern extract (FLE) was introduced to the cell by flood, creep, and microdrop, the resulting light signal passed through a microscope to the cathode of an image intensifier, and the output of the intensifier on photographic film was recorded. The detection of adenosine triphosphate was accomplished and it is concluded that ATP, rather than being preferentially associated with the I band, is uniformly distributed along the longitudinal axis of the cell. (MCW)

26218 (ORNL-tr-2769) INFLUENCE OF TEMPERATURE ON THE EMBRYONIC DEVELOPMENT OF TAPEWORMS OF TRIAENOPHORUS GENUS (PSEUDOPHYLLIDEA). Kuperman, B. I. Translated by E. J. Zuckerman from Biol. Vnutr. Vod, Inform. Byull.; No. 11, 32-37(1971). 7p. Dep. NTIS $4.00.

The embryonic development of tapeworms of Triaenophorus genus in natural conditions takes place in the coastal zone of fresh and brackish reservoirs. The influence of water temperature on the term of development of the embryo in eggs of Triaenophorus was studied at temperatures of 5 to 28°C at increments of 3 to 4 degrees. Each species of Triaenophorus is suited to development under varying temperature conditions. T. crassus is more sensitive to an increase in temperature than is T. nodulosus. At temperatures of 23 to 24°C, the development of the embryo in the eggs of T. crassus takes 1 to 2 days less than for T. nodulosus; then, at temperatures of 17 to 20°C the terms of development of the two species coincide. (MCW)

26219 (ORNL-tr-2852) MULTIPLICATION OF BACTERIA OF BCG STRAIN IN THE TISSUE CULTURE. Rozenberg, A. M. Translated by M. Gerrard from Zh. Mikrobiol., Epidemiol. Immunobiol.; 44: No. 5, 120-123(1967). 8p. Dep. NTIS 4.00.

Multiplication of bacteria of BCG vaccine strain in the tissue culture was studied. Investigations demonstrated that BCG strain multiplied actively in the cultures of chick, mouse, and human fibroblasts. In working with the mentioned types of tissue cultures a dose of 10^{-6} mg proved to be optimal for the study of BCG multiplication by the method of culturing. The greatest BCG strain multiplication was noted in the human fibroblast culture, and the least—in chick fibroblasts, the culture of mouse fibroblasts occupied an intermediate position in this respect. In all types of tissue cultures of BCG multiplication in the fluid phase was more intensive than in cells. (auth)

26220 (ORNL-tr-2853) RESULTS OF STUDYING BCG VACCINE IN TISSUE CULTURE. Rozenberg, A. M. Translated by M. Gerrard from Zh. Mikrobiol., Epidemiol. Immunobiol.; 47: No. 2, 13-18(1970). 6p. Dep. NTIS $4.00.

The possibility of differentiation of the BCG preparations by the reproduction intensity of these bacilli in the culture of human fibroblasts was studied. Along with Soviet intradermal vaccine, there were employed preparations from Canada, Switzerland, England, Sweden, and Senegal. Some of the vaccine series were concurrently studied in the tissue culture and on laboratory animals. The method employed offered a possibility of differentiating BCG preparations made from various substrains by the intensity of their reproduction in the fibroblast culture. The results of experiments in the tissue culture coincided with the data of parallel experiments on determination of survival of bacilli in the organism of laboratory animals. (auth)

26221 (RLO-2227-T12-44) GROWTH RESPONSE OF A MARINE PHYTOPLANKTON COCCOLITHUS HUXLEYI, TO VARIOUS CHEMICAL FORMS OF COBALT. Longaker, H. L. (Oregon State Univ., Corvallis (USA)). Jun 1974. 61p. Dep. NTIS $6.25.

Thesis.

The results suggest that a complexed form of cobalt is more efficacious in promoting growth of a marine phytoplankton than ionic cobalt. The phytoplankton used was Coccolithus huxleyi, a vitamin B_{12} producer, and the cobalt complex was cobalt(II)-ethylenediaminetetracetic acid [Co(II)-EDTA]. A review of the biochemistry of vitamin B_{12} indicates that a B_{12} producer might prefer, if not require, Co(III) instead of Co(II). Since some of the Co(II)-EDTA in the preliminary experiment might have become oxidized to Co(III)-EDTA, the observed stimulation of growth could have been due to Co(III)-EDTA. Two experiments were performed to determine if Co(III)-EDTA is more efficacious in stimulating growth than Co(II)-EDTA. Coccolithus huxleyi, grown in batch cultures with constant illumination, was used. One experiment had cobalt concentrations of 10 and 1 $\mu g/l$; the other had concentrations of 1 and 0.1 $\mu g/l$. There were no observed differences in specific growth rates between treatments of Co(III) as the EDTA complex with 10^{-6} M additional EDTA and Co(II) with 10^{-6} M EDTA. Both of these treatments resulted in a specific growth rate larger than controls without added EDTA or cobalt. It is not possible to measure the amount of Co(II)-EDTA that is oxidized to Co(III)-EDTA at the concentrations used in these experiments. Consequently these results cannot be used as a basis for rejecting the hypothesis that Co(III) is the required form of cobalt. Since Co(III)-EDTA without the additional 10^{-6} M EDTA was apparently able to stimulate growth in relation to the controls, it is assumed that C. huxleyi is capable of utilizing this form of cobalt. (auth)

26222 (SAN-730X5) STUDIES OF CONTROL MECHANISMS OF COMPLEMENT AND ITS BIOLOGICALLY ACTIVE PRODUCTS. Final Report, May 15, 1967–August 14, 1973. (Scripps Clinic and Research Foundation, La Jolla, Calif. (USA). Dept. of Experimental Pathology). 1973. Contract AT(04-3)-730. 17p. Dep. NTIS $4.00.

26223 (SLA-74-5158) FORMATION OF THE BACTERIAL FLAGELLAR BUNDLE. Anderson, R. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 14p. (CONF-740721-1). Dep. NTIS $4.00.

From symposium on swimming and flying in nature; Pasadena, California, USA (8 Jul 1974).

26224 (UCID-15657) STEREOVECTORCARDIOGRAPHY: A REVIEW. Saunders, B. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1969. 101p. Dep. NTIS $8.25.

26225 (UCLA-12-965) MINERAL NUTRITIONAL DIFFERENCES IN AN IRON EFFICIENT AND AN INEFFICIENT CORN HYBRID AND THEIR RESPONSES TO IRON CHELATES. Wallace, A.; Romney, E. M.; ElGazzar, A.; Clark, R. B.; Alexander, G. V. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1974. Contract AT(04-1)-GEN-12. 14p. (CONF-740913-1). Dep. NTIS $4.00.

From 7th international colloquium on plant analysis and fertilizer problems; Hannover, F. R. Germany (Sep 1974).

26226 (UR-3490-550) SENSATION AND PERCEPTION OF MICROWAVE ENERGY. Michaelson, S. M. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1974. 12p. (CONF-740658-1). Dep. NTIS $4.00.

From 7th international conference on environmental toxicity—fundamental and applied aspects of nonionizing radiation; Rochester, New York, USA (5 Jun 1974).

Sensing or perception of microwave/radiofrequency energy is accomplished through various mechanisms. In mammals, the main phenomena of sensation or perception are those of thermal sensations and, in selected cases, audition. Thermal sensation is accomplished by stimulation of thermosensitive nerve endings in the skin. Although some investigators believe that hearing or audition is evidence of direct nerve stimulation, the most recent data show this phenomena to be due to electromechanically induced vibrations in tissue and normal reception in the cochlea of the ear. (auth)

26227 (UR-3490-566) REDUCED ARTERIAL OXYGEN FLOW AND RESPIRATORY ALKALOSIS FOLLOWING MYOCARDIAL INFARCTION: ROLE OF HEMOGLOBIN–OXYGEN AFFINITY IN THE MAINTENANCE OF OXYGEN CONSUMPTION. Lichtman, M. A.; Cohen, J.; Young, J. A. (Rochester Univ., N. Y. (USA). School of Medicine and Dentistry). 1974. 24p. (CONF-740548-1). Dep. NTIS $4.25.

From annual meeting of the Association of American Physicians; Atlantic City, New Jersey, USA (7 May 1974).

Materials

26228 (BDX-613-1170) LIGHT LOAD FRICTION COEFFICIENT AND WEAR STUDY OF THREE BONDED SOLID LUBRICANTS. Technological Spinoff Report. Pope, D. P. (Bendix Corp., Kansas City, Mo. (USA)). Aug 1974. Contract AT(29-1)-613. 19p. Dep. NTIS $4.00.

Light load coefficient and wear life data were compiled for Electrofilm 77S, 4396, and 4396S bonded dry film lubricants. Static and dynamic friction performance was studied using a tribometer specially designed to test bonded films. Mean and standard deviations were calculated for comparison. Electrofilm 77S, the data indicated, was better for light load applications. (auth)

26229 (BDX-613-1171) EFFECTS OF THERMAL EXPANSION ON EPOXY GLASS LAMINATES. Technological Spinoff Report. Combs, E. E. (Bendix Corp., Kansas City, Mo. (USA)). Aug 1974. Contract AT(29-1)-613. 40p. Dep. NTIS $4.00.

A study was made of the effects of thermal expansion on epoxy glass laminates used to manufacture solder dipped and leveled printed wiring boards. Gradual or instant shock encountered during the process cycle was found to have no adverse effects on circuit board quality during normal manufacturing and rework. (auth)

26230 (BDX-613-1172) SOLVENT ANALYSIS OF STRESSES IN MOLDED POLYCARBONATE PARTS. Technological Spinoff Report. Walter, C. L. (Bendix Corp., Kansas City, Mo. (USA)). Aug 1974. Contract AT(29-1)-613. 28p. Dep. NTIS $4.00.

Specific molded polycarbonate parts were found to stress crack during molding, cleaning, and handling. Cleaning processes were evaluated for their detrimental effects on polycarbonate and revised processes were recommended. The effects of solvents, heat transfer oils, marking methods, and mold releases on polycarbonate were determined. Marking methods presently used and mold releases for polycarbonate were found to be compatible when used properly. A solvent stress analysis method was developed to determine the stress in molded polycarbonate parts. (auth)

26231 (CEA-CONF-2609) PROGRESS REALIZED IN THE AUTOMATIC CONTROL BY ULTRASONICS OF WELDS OF AUSTENITIC STAINLESS STEEL USING FOCALIZED TRANSDUCERS. Saglio, R.; Roule, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91—Gif-sur-Yvette (France). Dept. de Technologie). Feb 1973. 4p. (In French). (CONF-731084-1). Dep. NTIS (US Sales Only) $4.00.

From international colloquium on the welding of austenitic steels meeting; Brussels, Belgium (8 Oct 1973).

26232 (COO-1198-1082) SEARCH FOR MAGNETO-FLICKER NOISE IN POTASSIUM. Hockett, R. S. (Illinois Univ., Urbana (USA)). May 1974. Contract AT(11-1)-1198. 101p. Dep. NTIS $8.25.

Thesis.

A search has been made for a magnetic field-dependent flicker noise in potassium, predicted by the Charge Density Wave (CDW) model of the alkali metals. The search was made in high-purity encapsulated K wires over 1 m. long with diameters .023" and .010". The specimens were prepared by degassing high-purity

K, vacuum filling long thin plastic (.023" i.d.) or cupro nickel (.010" i.d.) tubing with molten K, and using a temperature gradient for controlled solidification. The search was made up to 44 kG fields and 1.5 amperes d.c. currents. No magneto-flicker noise was found from 10 Hz to 10 kHz greater than or equal to 4nV that is the minimum detectable signal. The non-observance of the magneto-flicker noise in the plastic-encapsulated samples of .023" i.d. indicates a discrepancy $\sim 10^6$ in the mean square noise voltage of the magneto-flicker noise, as predicted by the original CDW model. An analysis of the data on the cupro nickel-encapsulated samples of .010" i.d. indicates that the samples have voids with a total length ~1% of the sample length and thin K films ($\sim 1\frac{1}{2}\mu$ thick) connecting the K regions separated by the voids. The non-observance of the noise in these thin films indicates discrepancy $\sim 10^3$ in the mean square noise voltage of the magneto-flicker noise, as predicted by the revised CDW model. With the possible exception of unknown boundary effects, no adequate explanation has been found for the discrepancy in the prediction of the revised CDW model. This suggests that the CDW model cannot be used to explain the anomalous electronic transport properties of K. (auth)

26233 (DP-MS-74-17) METALLOGRAPHIC STUDIES OF HYDROGEN-EMBRITTLED NICKEL. Louthan, M. R. Jr.; Caskey, G. R. Jr.; Donovan, J. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 19p. (CONF-740812-3). Dep. NTIS $4.00.

From 7th annual international Metallographic Society technical conference; Gatlinburg, Tennessee, USA (4 Aug 1974).

The reduction in area at fracture and the fracture mode of polycrystalline Marz grade (99.995%) nickel are significantly affected by testing in 69-MPa gaseous hydrogen, even when specimens are prestrained to the limit of uniform elongation before hydrogen exposure. The combined tensile and metallographic observations indicate very rapid hydrogen abosrption during plastic deformation. It is postulated that hydrogen is transported to internal boundaries by mobile dislocations thereby causing localized, high hydrogen concentrations. These observations are consistent with an embrittlement mechanism in which hydrogen promotes boundary decohesion, either by enhancing glide (shear) processes, lowering the binding energy, or changing constraint conditions at microcracks. (auth)

26234 (ITF-74-66P) CYLINDRICAL MAGNETIC DOMAINS IN THICK FERROMAGNETIC FILMS. Bar'yakhtar, V. G.; Gann, V. V.; Gorobets, Yu. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The properties of cylindrical magnetic domains on thick ferromagnetic platelets were studied. The analytic expressions for cylindrical magnetic domain lattice parameters depending on the magnitude of external magnetic field were obtained. The problem of stability of such a lattice was explored. The dependence of cylindrical domain form upon the magnitude of the external magnetic field was obtained. (tr-auth)

26235 (JINR-P14-7986) PHASE DIAGRAM OF HEMATITE IN A MAGNETIC FIELD. II. High-Temperature Modification. Balanda, M.; Nitts, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Thermodynamical analysis is made of the behavior of weak ferromagnetic modification of hematite in the external magnetic field. A complete phase diagram is constructed for magnetoregulated hematite states in a field directed in a symmetry plane. The temperature dependence of some anisotropy constants above the Morin point is analyzed. (tr-auth)

26236 (JUL-1062-RA) EXPERIMENTS WITH POLYURETHAN RIGID FOAM ON BASIS OF ^{14}C-LABELLED DIPHENYLMETHANE-DIISOCYANATE (MDI) ON THE MINERALIZATION AND UPTAKE BY PLANTS. Fuehr, F.; Mittelstaedt, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Arbeitsgruppe Radioagronomie). Apr 1974. 33p. (In German). Dep. NTIS (US Sales Only) $4.75.

Experiments were conducted with the diphenylmethane-^{14}C-labelled polyurethane rigid foam Baystrat on the mineralization and uptake of labelled carbon during rooting of cuttings and layering in Baystrat blocks and by intact plants from soil/Baystrat mixtures. Baystrat was found to be highly resistant against microbial decomposition. During the initial phase of decomposition mineralization rates of 0.003%/day were registered, however, in a long term experiment in the soil the average mineralization amounted to only 0.3%/year. Due to this it can be concluded that only a very limited portion of receivable low molecular compounds are formed during the decomposition of Baystrat. In short term experiments (up to 60 days) leaves and stems of tomato, cucumber, and strawberry plants contained amounts of labelled carbon that represent up to 5 ppm Baystrat-equivalent in the fresh weight. However, in long-term experiments (90 to 185 days) after addition of Baystrat to soil only about 0.1 ppm was detectable, but fruits showed less than 0.01 ppm. (auth)

26237 (LBL-2251) CHARACTERIZATION OF BRITTLE CRACK INITIATION IN WELDED A-36 AND A-537 STEELS. Offer, H. P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1974. Contract W-7405-Eng-48. 88p. Dep. NTIS $7.50.

Thesis.

26238 (LBL-2764) CRYOGENIC PROPERTIES OF Fe–Mn AND Fe–Mn–Cr ALLOYS. Schanfein, M. J.; Yokota, M. J.; Zackay, V. F.; Parker, E. R.; Morris, J. W. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 28p. (CONF-740549-1). Dep. NTIS $4.50.

From symposium on properties of materials for liquid natural gas tankage; Boston, Massachusetts, USA (21 May 1974).

A wide range of microstructures were obtained in Fe–Mn alloys by varying the manganese and chromium contents. When a bcc (α) structure was produced, increasing amounts of manganese were found to be detrimental to low temperature toughness. At manganese levels greater than 12% where appreciable amounts of ϵ and γ phases formed the ductile-brittle transition temperature dropped rapidly. In terms of the ($\epsilon + \gamma$) phases present, the ductile-brittle transition temperature decreased at a rate of 1.3°C/vol % ($\epsilon + \gamma$). Increasing the ($\epsilon + \gamma$) content to achieve good low temperature toughness, however, also caused a decrease in the yield strength. Increases in the yield strength were achieved without appreciable increase in the ductile-brittle transition temperature by greater manganese additions and by chromium additions. (auth)

26239 (LBL-2771) MICROSTRUCTURAL FEATURES AFFECTING FRACTURE TOUGHNESS OF HIGH STRENGTH STEELS. Parker, E. R.; Zackay, V. F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1974. Contract W-7405-eng-48. 17p. (CONF-740824-1). Dep. NTIS $4.00.

From international United States-Japan conference on fracture mechanics; Sendai, Japan (12 Aug 1974).

The fracture toughness of quenched and tempered steels, such as AISI 4340, AISI 4130, and 300M, can be increased by 50 to 100 percent by minor changes in heat treating procedures. Certain microstructural features, particularly blocky ferrite, upper bainite, and twinned martensite plates, are deleterious to fracture toughness. Similarly, the presence of undissolved carbides and sulfide inclusions, which act as crack nuclei, can lower fracture toughness by 25 to 50 percent. Other microstructural constituents, such as lower bainite, autotempered martensite, and retained austenite can enhance fracture toughness. By controlling the amounts and distributions of the microstructural constituents, the fracture toughness values of AISI 4340, AISI 4130, and 300M can be raised to the fracture toughness level of 18Ni maraging steel at equivalent values of yield strength. (auth)

26240 (MLM-2113) PETN STABILITY AND COMPATIBILITY. Colman, D. M.; Rogers, R. N. (Mound Lab., Miamisburg, Ohio (USA)). 15 Jul 1974. Contract AT-33-1-GEN-53. 9p. Dep. NTIS $4.00.

The decomposition kinetics of pentaerythritol tetranitrate (PETN) alone and in admixture with other materials has been studied using a differential scanning calorimeter. Quantitative rate and reaction order(s), as a function of composition, were obtained. It is possible to calculate the reaction order of the decomposition from the data as well as the pre-exponential and energy of decomposition the Arrhenius rate equation, $k = Ae^{-E/RT}$ or $k = Ze^{-E/RT}$. Changes in the foregoing parameters, singly or in combination, tend to indicate the degree of compatibility of the materials undergoing the test. In order to postulate a reaction mechanism(s), reaction products must be identified. An attempt to identify reaction products was begun by using a pyrolysis–thin layer chromatographic procedure. Though the evidence obtained was from a dynamic mode of operation, the experiments could have been done isothermally. An approximate temperature for the presence of formaldehyde was found to be 398°K, which is below the melting point of PETN. When the test was made using EXON 461 alone, chlorine was found at approximately 433°K. (auth)

26241 (ORNL-tr-2835) EFFECT OF NITROGEN CONCENTRATION ON SHORT- AND LONG-TERM BEHAVIOR OF UNSTABILIZED AUSTENITIC 18/14 CrNi STEEL. Schirra, M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). [nd]. Translation by R. G. Mansfield of KFK-Ext.-6/73-5. 28p. Dep. NTIS $4.50.

The effect of the nitrogen concentration in two melts containing

0.04% and 0.14% N on the short- and long-term creep-strength behavior of an unstabilized 18/14 CrNi steels at temperatures up to 800°C was studied experimentally. Raising the nitrogen concentration from 0.04% to 0.14% slightly increases the elastic limit and the tensile strength, decreases the elongation at fracture, but did not significantly affect the proportional elongation. The creep strength values are also improved, but an unequivocal effect on the values of the ductility in the creep experiment was not detectable. The experimental results are compared with data in the literature on the effect of nitrogen concentration in steels with 15–18% Cr, 6–20% Ni, 0–10% Mn and 0–2% Mo. (auth)

26242 (ORNL-tr-2840) TRANSFORMATION IN Fe–Ni–Al ALLOYS CONTAINING Cr. Kucherenko, L. A.; Troshkina, V. A. Translated from Vestn. Mosk. Univ., Ser. II. Khim.; No. 2, 191-194(1973). 4p. Dep. NTIS $4.00.

The heat capacity of the alloys Fe–Ni–Al with chromium additions was measured in a quasi-adiabatic calorimeter in the temperature range 20 to 650°C. The specific resistance of the alloys was measured in the temperature range 20 to 1000°C. The exothermic conversion within 500 to 600°C upon heating was observed in quenched alloys. (auth)

26243 (SAND-74-5238) COMMENTS ON THE THEORY OF LOCALIZED STATES IN NONCRYSTALLINE SEMICONDUCTING SOLIDS. Emin, D. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 36p. (CONF-740718-1). Dep. NTIS $5.00.

From advanced study institute on physics of structurally disordered solids; Kingston, Rhode Island, USA (29 Jul 1974).

After presenting examples of so-called localized states in crystals and commenting on the nature of electronic states in disordered solids, the question of the relationship between the nature of the eigenstates of an electron in a rigid noncrystalline solid and its transport properties is addressed. It is pointed out that the absence or presence of a finite-temperature thermally-activated mobility does not necessarily follow from the electronic states being extended or localized, since electron-lattice interaction often plays a major role in determining the transport properties of a solid. The effect of the electron-lattice interaction on the electronic eigenstates of a deformable solid, characterized by a short-range electron-lattice interaction, is then discussed at length. In particular, the question of when it is a reasonable first approximation to neglect the electron-lattice interaction in studying the eigenstates of the system is considered. When this approximation fails, the charge carriers are best treated as localized small polarons. Finally, the situations which characterize small-polaron formation in disordered insulators are outlined. (auth)

26244 (SAND-74-5255) LINEAR AND NONLINEAR PIEZOELECTRIC CONSTANTS OF QUARTZ, LITHIUM NIOBATE, AND LITHIUM TANTALATE. Graham, R. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 6p. (CONF-740816-1). Dep. NTIS $4.00.

From the microwave acoustics symposium; Lancaster, UK (1 Aug 1974).

Techniques ordinarily employed for very large strain or high pressure experiments were employed to determine certain linear and nonlinear piezoelectric constants of quartz, lithium niobate and lithium tantalate. The observed nonlinear constants are large and relatively easy to detect. (auth)

26245 (SLA-73-0925) CHEMICAL VAPOR DEPOSITION OF CARBON ON CARBON FIBERS. Pierson, H. O.; Lieberman, M. L. (Sandia Labs., Albuquerque, N. Mex. (USA); Sandia Labs., Livermore, Calif. (USA)). Aug 1974. Contract AT(29-1)789. 36p. Dep. NTIS $5.00.

The relations between chemical vapor deposition (CVD) parameters and the resultant pyrolytic carbon microstructures were examined for matrix deposition in fibrous carbon substrates. The parameters considered are temperature (1200 to 1450°C), pressure (20 to 630 torr), C/H ratio ($\frac{1}{4}$ to $\frac{1}{14}$), total flow rate 2 to 16 l/min), and carbon felt density (0.12 to 0.23 g/cm^3). Most of the data obtained are in agreement with a CVD model for carbon; where agreement is not obtained, it is surmised that the assumptions of the model may not be satisfied. (auth)

26246 (SLA-74-0217) DEVELOPMENT OF A COMPLIANT BONDING CAPABILITY FOR BEAM LEAD DEVICES. Bushmire, D. W.; Chavez, E. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 26p. Dep. NTIS $4.50.

Compliant beam lead bonding is a method of thermocompression bonding that is relatively insensitive to variations in device beam hardness and thickness. It also permits the beams to be bonded with minimum bugging. An acceptable range of bonding parameters was developed by bonding and testing 200 devices. The optimized parameters were tool force (12 to 35 lbs), tool temperature (300 to 600°C), substrate temperature (200 to 250°C), and bond time (1 to 5 sec). (auth)

26247 (SLA-74-0345) TEST RESULTS ON THE EFFECT OF HEATING A CONFINED HIGH EXPLOSIVE. Donaldson, A. B.; Lee, D. O. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 19p. Dep. NTIS $4.00.

The effects of confinement and heating on high explosives are investigated to provide a basis for predicting the response of weapons to thermal environments such as might be produced by a fuel fire. Cases studied include those for both PBX-9404 and X-0219 (90% TATB/10% KelF) explosives, subjected to slow heating (external resistive heater), fast heating (fuel fire), and burn initiation at the surface by a tungsten foil. The HE was either moderately confined by a steel container with thermal standoff for the HE or it was unconfined. (auth)

26248 (SLA-74-5413) WAVE PROPAGATION CALCULATIONS FOR NONLINEAR VISCOELASTIC SOLIDS. Nunziato, J. W.; Schuler, K. W.; Hayes, D. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 11p. (CONF-740904-2). Dep. NTIS $4.00.

From 1st international conference on computational methods in nonlinear mechanics; Austin, Texas, USA (23 Sep 1974).

A numerical algorithm was developed to study one-dimensional wave propagation in nonlinear viscoelastic solids. This algorithm is based upon the observation that the constitutive theory for viscoelastic solids can alternatively be formulated in terms of a theory of materials with internal state variables. This reformulation results in a system of algebraic and first-order differential equations which, along with the one-dimensional field equations, can be finite differenced and solved numerically. Numerical solutions have been obtained for several wave propagation problems involving shock loading of the polymer polymethyl methacrylate and were found to be in good agreement with experimental observations. (auth)

26249 (SLA-74-5416) COMPUTATION OF STRESS WAVE PROPAGATION IN COMPOSITE MATERIALS. Drumheller, D. S.; Sutherland, H. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 11p. (CONF-740904-1). Dep. NTIS $4.00.

From 1st international conference on computational methods in nonlinear mechanics; Austin, Texas, USA (23 Sep 1974).

The submicrosecond nonlinear response of a porous, viscoelastic, fiber-reinforced composite material to a suddenly applied load was analyzed numerically. These calculations, which draw on a cloth-laminate quartz phenolic, illustrate basic wave-propagation phenomena associated with typical engineering composites. (auth)

26250 (UCID-15405) PRELIMINARY STUDY OF TRIP STEEL. Goldberg, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Nov 1968. Contract W-7405-eng-48. 36p. Dep. NTIS $5.00.

Some preliminary observations are reported on the stability and transformation behavior of a TRIP (transformation-induced plasticity) alloy. In the austenitic condition, the alloy exhibited relatively high stability against precipitation and subsequent transformation when it was exposed for relatively long periods of time (up to 1 month) at temperatures close to its recommended ausforming temperature of 460°C. Extensive precipitation was obtained by heating for 719 hr at 555°C; however, no evidence could be found that any ferromagnetic phase (ferrite or alpha-martensite) had formed either at 555°C or during the subsequent cooling to liquid-nitrogen temperature. This conclusion was based on dilatometric, x-ray diffration, magnetic, and microscopic observations. A ferromagnetic phase formed after heating for 77 hr at 675°C. Dilatometry indicated that this phase appeared during cooling. The amount of ferromagnetic phase increased with an increase in time at 675°C. The presence of any martensite, however, could not be revealed by metallographic observations (optical and electron carbon replication). Cylindrical specimens of the TRIP alloy were deformed to determine the effect of strain, strain rate, and temperature of deformation on martensite of deformation. Significant amounts of the ferromagnetic phase were detected only after deformation at subzero temperatures. Specimens were deformed up to 80 percent reduction in compression. Extensive banding, which was attributed to mechanical twinning, was frequently observed in the deformed specimens. The density of bands was found to be insensitive to strain rate over a range of rates from 6.5×10^{-5} min^{-1} to almost 100 min^{-1} for cylinders compressed to 30 percent at 25°C. This density was observed to decrease with an increase in deformation temperature. The martensite of deformation could not readily be detected by metallography. As revealed by magnetic induction measurements and supported by x-ray diffraction results, the amount of martensite of deformation formed at a given temperature depended on the prior solutionizing temperature and on the amount of deformation. (auth)

26251 (UCID-15418) MECHANICAL PROPERTIES OF PLASTICS FOAMS. Part C. Engineering Data on Foams, Using Spherical Shapes. Hammon, H. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1968. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

Data determined on hemishells or hollow spheres of plastics foams of polystyrene and polypropylene are discussed. A steel ball 4.25 in. in diameter was placed in the center, and the foam hemishell or hollow sphere was placed within an Al shell about 7 in. ID. The shell, and the foam, had a hole about 1 in. diameter so that a push rod could contact the inner ball and apply stress. Compression strengths are summarized for various configurations. (MCW)

26252 (UCID-15419) MECHANICAL PROPERTIES OF PLASTIC FOAMS. Part B. Time Dependent Behavior of Polystyrene Bead Foam. Rinde, J. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). [nd]. Contract W-7405-eng-48. 12p. Dep. NTIS $4.00.

The effect of strain rate on the compressive properties of hot-gas processed polystyrene bead foam was determined over the range 1×10^{-3} to 1 min^{-1} at 72 ± 2°F. Over this range the properties increase with increasing testing speed by about 30 percent. (MCW)

26253 (UCID-15421) POISSON'S RATIO OF RIGID PLASTIC FOAMS. Rinde, J. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). [nd]. Contract W-7405-eng-48. 18p. Dep. NTIS $4.00.

Poisson's ratio for several low-density rigid plastic foams was determined in both tension and compression. For polystyrene and polypropylene foams Poisson's ratio was greater in tension than compression. In compression Poisson's ratio was not linear, showing a larger value below the yield strain and a value near zero for high strains. For 0.05 and 0.10 g/cc polystyrene bead foam Poisson's ratios were 0.36 and 0.25, respectively, in tension and in compression 0.10 and 0.11 below the yield strain and 0.03 for both densities at high strains. (auth)

26254 (UCID-15421(Rev.1)) POISSON'S RATIO FOR RIGID PLASTIC FOAMS. Rinde, J. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Apr 1969. 17p. Dep. NTIS $4.00.

Poisson's ratio for several low-density rigid plastic foams was determined in both tension and compression. For polystyrene bead foams, Poisson's ratio is greater in tension than compression. In compression, Poisson's ratio is not linear, showing a larger value below the yield strain and a value near zero for high strains. For 0.05 and 0.10 g/cc polystyrene bead foam, Poisson's ratios are ⅓ in tension and ¼ in compression below the yield strain; at higher strains the value in compression is 0.03. (auth)

26255 (UCID-15422) EFFECT OF AGING AT 160°F ON THE PROPERTIES OF RATTAN C. Cady, W. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). [nd]. Contract W-7405-eng-48. 4p. Dep. NTIS $4.00.

Results are given for Rattan C aging at 160°F. Up to 240 days, tensile strength is not affected by heat, but elongation at break is significantly reduced. The degree of cross-linking as indicated by swell ratio is essentially unchanged after 60 days. The thermal coefficient of linear expansion as measured by the mercury dilatometer volumetric method decreases. The computed value for range of −65 to 165°F seems to be dropping at 420 days. The TCLE from 17 to 165°F stabilizes at 120 days seemingly. Stabilized Rattan C appears to have enough elongation and a high enough TCLE to fulfill its functions of matching the thermal characteristics of high explosive. (MCW)

26256 (UCID-15424) TRANSITION TEMPERATURES AND CRYSTALLINITY IN EVA, VCE AND RATTAN C. Cady, W. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). [nd]. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

There are five thermal transitions between about −100 and 100°C in VCE gums; cured, unfilled VCE, and Rattan C. Four of these are glass transitions that were tentatively identified as due to various segments of the random terpolymer. The fifth is a melting point of crystalline ethylene repeat units in the vicinity of 40 to 50°C. Crystallinity decreases with increasing vinyl acetate content. Hydrolysis of the acetate units to hydroxyl units tends to increase crystallinity, as the hydroxyl group is not as effective as the acetate group in interrupting crystallinity of the ethylene segments. The relative effectiveness of the acetate and hydroxyl groups in lowering crystallinity is roughly proportional to their lengths. (MCW)

26257 (UCID-15425) RHEOLOGY OF FILLED SYSTEMS. Lepper, J. K.; Hetherington, N. W.; Jessop, E. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). [nd]. Contract W-7405-eng-48. 34p. Dep. NTIS $4.75.

The flow and moldability behavior of filled elastomers was studied on a variety of particulate metals, oxides, carbides, and nitrides that were incorporated with conventional two-roll rubber mills into a polymer. Filled elastomers used were boron-filled Neoprene; Rattan C, ethylene-vinyl-acetate-vinyl-alcohol terpolymer (VCE); and Caribou, VCE. All are compression molded to shape. It is concluded that the moldability of filled elastomers can be predicted from compressive-shear data if the deflection axis is referenced to density. (MCW)

26258 (UCID-15465) EXPERIMENTAL STUDY OF THE HIGH-TEMPERATURE MECHANICAL PROPERTIES OF PALLADIUM–SILVER. Prado, M. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1969. 23p. Dep. NTIS $4.25.

Mechanical properties of a palladium-silver (75% Pd/25% Ag) between 300 and 600°C are presented. The behavior of the material was generally as expected. As the temperature was increased the elongation dropped. The drop in elongation is attributed to the possible formation of a hard surface oxide film that increases the rate of work hardening of the Pd–Ag. (auth)

26259 (UCID-15532) EQUATION OF STATE FOR SOLIDS BASED ON MEASUREMENTS AT AMBIENT PRESSURE. Lee, E. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1969. 19p. Dep. NTIS $4.00.

In many instances it is necessary to generate an approximate equation of state for a solid material at high pressure for which there is little or no high-pressure data. It is desirable to express this equation of state as a polynomial to be consistent with calculational methods that are in common use. By transforming the Birch–Murnaghan equation and by making some simplifying assumptions about the dependence of pressure on temperature, a fairly reliable equation of state is obtained. The equation requires only three measured differential quantities: the compressibility, coefficient of expansion, and the heat capacity—all of which can be measured at or near ambient pressure. Where high-pressure data is available, the equation can be adjusted to provide very close agreement. The formulation is such that there is a direct transformation from P-V-T to P-V-E representation. Comparisons with high-pressure data are given, and an example of such an equation of state in both P-V-T and P-V-E variables is given for one material. (auth)

26260 (UCID-15533) SURVEY OF MAGNETIC PROPERTIES OF MATERIALS. Maxam, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1969. 24p. Dep. NTIS $4.25.

26261 (UCID-15553) INVESTIGATIONS INTO THE FREQUENCY RESPONSE CHARACTERISTICS OF MAGNETIC CORES. McCann, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Sep 1969. 66p. Dep. NTIS $6.50.

A summary is given of recent work to obtain a more complete understanding of a laminated steel core from a measurement of its magnetic impedance as a function of frequency. A generalized theory was derived of magnetic impedance to include the ferrites. Section material included a review of magnetic circuit theory and electromagnetic theory of magnetic materials. (MCW)

26262 (UCID-15562) ADHESIVE TESTING. Lepper, J. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Dec 1969. 15p. Dep. NTIS $4.00.

26263 (UCID-15587) MOISTURE VAPOR TRANSMISSION OF POLYSTYRENE BEAD FOAMS. Hammon, H. G.; Buckner, A. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Dec 1969. 10p. Dep. NTIS $4.00.

Water vapor transmission (WVT) and permeability were determined for polystyrene bead foams at several combinations of temperature and humidity and at three thicknesses of foam, 0.5 in., 1 in., and 1.5 in. A modified ASTM method was used, in which the foam specimen is sealed into the top of a cut-off glass beaker above a large excess of anhydrous calcium chloride. The beakers are kept in a controlled temperature and humidity environment and weighed periodically. WVT is calculated after a uniform rate of weight gain is achieved. Moisture vapor transmission rates are higher for the older foam made from Dow SD-505 beads than foams made from the newer SD-572 beads. Average permeability (permeance times thickness) is nearly independent of foam thickness, temperature, and relative humidity, but is inversely proportional to foam density. The average permeability of foam made from SD-572 beads at density of 0.05 g/cm^3 is about 0.5 metric perm-cm, and at 0.1 g/cm^3, about 0.23 metric perm-cm. (auth)

26264 (UCID-15587(Rev.1)) MOISTURE VAPOR TRANSMISSION OF POLYSTYRENE BEAD FOAMS. Hammon, H. G.; Buckner, A. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Jun 1970. 9p. Dep. NTIS $4.00.

Water vapor transmission (WVT) and permeability were determined for polystyrene bead foams at several combinations of temperature and humidity and at three thicknesses of foam, 0.5 in., 1 in., and 1.5 in. (1.27, 2.54, and 3.81 cm). A modified ASTM method was used, in which the foam specimen is sealed into the top of a cut-off glass beaker above a large excess of anhydrous calcium chloride. The beakers are kept in a controlled temperature and humidity environment and weighed periodically. WVT is calculated after a uniform rate of weight gain is achieved. Moisture vapor transmission rates are higher for the older foam made from Dow SD-505 beads than foams made from the newer SD-572 beads. Average permeability (permeance times thickness) is nearly independent of foam thickness, temperature, and relative humidity, but is inversely proportional to foam density. The average permeability of foam made from SD-572 beads at density of 0.05 g/cm^3 is about 1.2 metric perm-cm, and at 0.1 g/cm^3, about 0.6 metric perm-cm. (auth)

26265 (UCID-15594) MECHANICAL PROPERTIES OF FIBER-REINFORCED POLYSTYRENE-BEAD AND POLYURETHANE FOAMS. Rinde, J. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Jun 1970. 31p. Dep. NTIS $4.75.

Foams reinforced with graphite-epoxy fibers were made at densities from 0.04-0.25 g/cm^3 (2.5 to 15.6 lb/ft^3) with both one- and three-dimensional fiber reinforcements. Properties were determined of the foam-fiber composites primarily in compression, with some tensile and constant-load testing. Modulus values in both tension and compression are at least 100,000 psi (7000 kg/cm^2) for composites of 0.1 g/cm^3 (6.24 lb/ft^3) density containing 0.7 vol % graphite-epoxy fibers in both polystyrene-bead foam and a polyurethane foam. Compressive yield strengths were 250 to 300 psi (17.6-21.1 kg/cm^3) at this density, and tensile strengths are greater than the ability to bond to the fibers. Compressive properties were determined at the other densities and properties were predicted of some other foam-fiber composites at different fiber loadings and with different fibers. Low-density foam-fiber composites can be made by varying the fiber material, fiber volume fraction, foam type, and density. With this large range of variables, composites with properties ranging from low modulus-high strength to high modulus-high strength are possible. Probably the most interesting applications would arise where a low-density foam-fiber composite could be used to replace a full-density plastic with no loss in strength or modulus but with a weight savings as high as 90%. Other applications would be the replacement of a low-density foam by a composite at the same density but with a significantly higher modulus or strength, or both. One example of this type of replacement would be the use of a one-dimensional foam-fiber composite of low density and high strength modulus to replace part of the foam of the same density in an assembly. This composite could act as the main load-carrying support or as an anticreep support. (auth)

26266 (UCID-15629) YIELD BEHAVIOR OF SHOCK-COMPRESSED NaCl. Weidner, D. J.; Royce, E. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1969. 11p. Dep. NTIS $4.00.

Yield at the Hugoniot Elastic Limit (HEL) for NaCl crystals is probably due to yield in the $\{110\}$, $\langle 1\bar{1}0\rangle$ slip system, the system most easily activated quasistatically. The ratio of the shear stress induced in the slip direction (σ'_{12}) to the longitudinal shock stress (σ_{11}) is 0.37, 0.21, and 0.0 for the $\langle 100\rangle$, $\langle 110\rangle$, and $\langle 1\,11\rangle$ direction shocks, respectively. Thus, the observed HEL's of 0.26, 0.77, and 7.4 kbar reflect the difference in loading stress needed to produce yield at a critical shear stress resolved in the slip direction. The HEL for $\langle 1\,11\rangle$ crystals must be associated with yield on a second system, probably $\{111\}$, $\langle 1\bar{1}0\rangle$. The discontinuity first observed by Larson in $\langle 100\rangle$ crystals at 29 kbar can be explained as resulting from a reasonable 10 to 20 fold work hardening of the $\{110\}$, $\langle 1\bar{1}0\rangle$ slip system so that a second slip system, probably $\{111\}$, $\langle 1\bar{1}0\rangle$, is activated. (auth)

26267 (UCID-15688) THERMALLY CURED MASS CONCRETE: REACTION MASS OF HYDRAULIC SHAKER BUILDING 836, SITE 300. Szybalski, S.; Hunt, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jul 1970. 18p. Dep. NTIS $4.00.

The method used to cure a block of concrete 16 × 12 × 26 feet is described. The block is the reaction mass for a hydraulic shaker that is capable of vibrating a test package of 10,000 lb to an acceleration of 10 g. The vibration frequency will vary up to 500 Hz or to an amplitude of 2.5 in. The objective of this curing method was to obtain high-strength concrete and to reduce the possibility of cracks due to thermal stresses. The strength requirement of 5,000 psi dictated a high cement content, which resulted in high heat output from cement hydration. (auth)

26268 (UCID-16509) ABSTRACTS OF ADHESIVE COLLOQUIUM AT LLL, APRIL 24–25, 1974. Peck, L. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 May 1974. Contract W-7405-Eng-48. 21p. (CONF-740442-(Abstr)). Dep. NTIS $4.25.

From adhesives materials colloquium; Livermore, California, USA (24 Apr 1974).

An informal presentation of adhesive data has been made by the various AEC subcontractors on a yearly basis. Historically these meetings are an outgrowth of the inter-agency materials meetings. The meeting included fifteen papers dealing with all aspects of adhesive problems. A copy of the Agenda and abstracts of some of the papers are included. Copies of papers should be requested from each author. (TFD)

26269 (UCRL-75698) INSTRUMENT FOR IMPROVING THE QUALITY OF ELECTRON-BEAM WELDS. Leavitt, G. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jul 1974. 10p. (CONF-741014-2). Dep. NTIS $4.00.

From Instrument Society of America conference; New York, New York, USA (28 Oct 1974).

The first practical application of electron-beam welding was performed in 1950. Since that time, many exotic materials have been fashioned into structural and engineering components with this technique. The greater challenges of today's technology require better control of the process. A position interpreter that monitors the weld and provides a permanent record for the certification of the quality is described. It can also be readily adapted to computer control of beam position, thereby providing significant improvement in the quality of welds. (auth)

Physics and Engineering

26270 (BDX-613-1046) AUTOMATIC PEAK POWER MEASUREMENT OF SHORT RF PULSES. Technological Spinoff Report. Hardinger, K. E.; Peterson, E. E. (Bendix Corp., Kansas City, Mo. (USA)). Aug 1974. Contract AT(29-1)-613. 10p. Dep. NTIS $4.00.

A method was needed to measure the peak radiofrequency (rf) power of short-width rf pulses of the type used in telemetry and radar. A closed-loop pulse height leveling system was developed that can be constructed from readily available original equipment manufacturer (OEM) microwave and electronic components. The system measures peak power, to within ±0.5 dB, of pulsed or cw rf signals. (auth)

26271 (BDX-613-1053(Rev.)) READ-ONLY MEMORY IMPLEMENTATION STUDY. Final Report. Zimmerman, J. J. (Bendix Corp., Kansas City, Mo. (USA)). Aug 1974. Contract AT(29-1)-613. 56p. Dep. NTIS $4.00.

Electrically alterable read-only memory (ROM) units were incorporated into production test equipment. Production quantity costs of ROM's enable practical use of these large scale integrated (LSI) circuits in design of small-quantity equipment. One production tester is fully automated with six 4000-bit memories and twenty-two 256-bit memories as the control feature. (auth)

26272 (BDX-613-1104) DEVELOPMENT OF A LIGHT LOAD FRICTION TESTER. Pope, D. P.; Forman, G. W. (Bendix Corp., Kansas City, Mo. (USA)). [nd]. Contract AT(29-1)-613. 15p. (CONF-741012-1). Dep. NTIS $4.00.

From lubrication conference; Montreal, Canada (8 Oct 1974).

A new tribometer is described that measures friction characteristics of bonded dry film lubricants under light to moderate loads. Although this tester was designed specifically for loads of approximately 5 grams to several 100 grams, it operates satisfactorily at loads approaching 5 pounds. This apparatus, used as a friction coefficient measuring device, will yield performance data useful in comparing bonded lubricant formulas. As a research tool, it evaluates variation of friction with change in contact stress, contact load, and contact geometry. Controlled experiments using this apparatus might reveal information needed to understand the true nature of bonded film lubrication. (auth)

26273 (BDX-613-1116(Rev.)) EARLY PRODUCTION HISTORY ON HYBRID MICROCIRCUITS CONTAINING BEAM-LEAD SEMICONDUCTORS. Wiley, T. A. (Bendix Corp., Kansas City, Mo. (USA)). Aug 1974. Contract AT(29-1)-613. 29p. Dep. NTIS $4.00.

Data from hybrid microcircuit prototype development and early coded electronic-switch production revealed that the beam-lead devices used in these hybrids are more reliable than the chip-and-wire active devices used in previous applications. Yields at the various processing levels were better than expected, and the overall microcircuit yield was more than 50 percent. Because of stringent quality requirements, this yield is considered acceptable, but is improving with cumulative production experience. Seven types of microcircuits for the coded switch are now being manufactured on a scheduled basis, and current problems are not sufficient to adversely affect production schedules. (auth)

26274 (BDX-613-1130(Rev.)) ROUND-WIRE LAMINATED FLAT CIRCUITS. Hile, R. A. (Bendix Corp., Kansas City, Mo. (USA)). Aug 1974. Contract AT(29-1)-613. 20p. Dep. NTIS $4.00.

Round-wire, laminated flat cables provide an additional manufacturing capability that is particularly suited for development applications and few-of-a-kind production. These laminated cables do not require the special tooling that is necessary for molded cables; therefore, cost and lead time are reduced. Layup, lamination, and contouring techniques were developed for complex cable configurations, including small-radius bends and multiple breakouts. (auth)

26275 (BDX-613-1175) CHARACTERIZATION OF THERMOCOMPRESSION BONDING PARAMETERS FOR BEAM-LEAD BONDING. Youngberg, D. A.; Lenhardt, B. W. (Bendix Corp., Kansas City, Mo. (USA)). 1974. Contract AT(29-1)-613. 24p. (CONF-741004-3). Dep. NTIS $4.25.

From international society of hybrid microelectronic symposium; Boston, Massachusetts, USA (21 Oct 1974).

Thermocompression (TC) bonding is a technique used to weld two similar materials by application of heat and pressure for a specific time. To obtain reliable, consistent beam-lead attachment by TC bonding, each bonding parameter value must be known and controlled. TC bonding schedules are developed to determine parameter boundary values that depend on the fundamental physics of the bonding process. This necessitates thorough TC bonder characterization (definitions of limits). Practical considerations of beam-lead wobble-tool bonding and techniques used to characterize bonding tool temperature, work-stage temperature, bond time or wobble speed, and bond force are discussed. (auth)

26276 (BDX-613-1176) REMOVAL OF HYBRID MICROCIRCUIT BEAM-LEAD DEVICES FOR POSTMORTEM TESTS. Lenhardt, B. W.; Youngberg, D. A. (Bendix Corp., Kansas City, Mo. (USA)). 1972. Contract AT(29-1)-613. 16p. (CONF-741004-1). Dep. NTIS $4.00.

From International Society of Hybrid Microelectronic symposium; Boston, Massachusetts, USA (21 Oct 1974).

Identification of the cause of a hybrid microcircuit malfunction often necessitates testing one or more of the beam-lead devices separately from the substrate on which it was bonded. This requires a removal technique that maintains the structural and electrical integrity of the device. This paper discusses a rework technique that will successfully remove beam-lead devices and do so without incurring structural or electrical damage to either the device or substrate metallization. (auth)

26277 (BDX-613-1182) ACTIVE LASER TRIMMER FOR PRODUCTION TRIMMING OF FUNCTIONAL HYBRID MICROCIRCUITS. Peters, J. A. (Bendix Corp., Kansas City, Mo. (USA)). [nd]. Contract AT(29-1)-613. 4p. (CONF-741004-2). Dep. NTIS $4.00.

From International Society of Hybrid Microelectronics symposium; Boston, Massachusetts, USA (21 Oct 1974).

The output functions for hybrid microcircuits are required to be within one percent or better of design value. A computer-controlled YAG laser trimmer was developed to increase the resistance of the deposited resistors that control output functions such as voltage, current, frequency, and time interval. The computer program contains information on each circuit transfer function and each related trim resistor to predict the required cut length. This system makes use of repetitive sampling during a short interval when power is applied to the circuit, and trimming is performed during a much longer interval when power is off. This provides for rapid trimming of functions with short duty cycles. Early results show that the active laser trimmer is a satisfactory production method for obtaining close-tolerance electrical functions. (auth)

26278 (BNL-19058) ENERGIES OF CONDUCTION BANDS IN DIELECTRIC LIQUIDS. Holroyd, R. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 23p. (CONF-740715-8). Dep. NTIS $4.25.

From 5th international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

Methods of determining the energy of the conduction band, denoted by V_0, as well as the relation of V_0 to other properties of the excess electron are discussed. Two methods of measurement are used: In one, the work function of a metal immersed in the liquid is measured. In the other, solutes (TMPD) are photoionized in the liquid and V_0 is calculated from the wavelength at which ionization onsets occur. A wide variation in conduction band energies is observed from a high of +0.21 eV for tetradecane to a low of −0.60 eV for tetramethylsilane. In general V_0 shifts to more negative values with increasing molecular symmetry, and correlates well with electron mobility. The photoionization results suggest that V_0 decreases with increasing temperature. In mixtures, V_0 is linearly dependent on mole fraction. It is found empirically for n-hexane-neopentane mixtures that $\log \mu$ is linearly dependent on V_0. This relationship also applies approximately to pure paraffinic hydrocarbons. Thus the dependence of electron mobilities and photoionization onsets on the conduction band energy is established. Recent evidence indicates that V_0 also influences the rates of electron reactions in these liquids. 30 references. (auth)

26279 (BNWL-SA-5036) DIFFUSION-DEPOSITION MEASUREMENTS AND MODELING. Elderkin, C. E.; Powell, D. C.; Nickola, P. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 7p. (CONF-740922-3). Dep. NTIS $4.00.

From symposium on atmospheric diffusion and air pollution; Santa Barbara, California, USA (9 Sep 1974).

An attempt was made to improve Gaussian plume dispersion descriptions by including recent advances in atmospheric turbulence and allowing for the turbulent flux of material to the surface by incorporating the desposition velocity. A diffusion-deposition model was assembled and then compared with data from elevated source particulate tracer experiments conducted over the Hanford diffusion grid in neutral through very stable conditions and the deposition velocity was evaluated for the various conditions of the experiments. (MCW)

26280 (COO-3077-43) THREE DIMENSIONAL FLOWS AROUND AIRFOILS WITH SHOCKS. Jameson, A. (New York Univ., N. Y. (USA). AEC Computing and Applied Mathematics Center). 1973. Contract AT(11-1)-3077. 29p. (CONF-731221-1). Dep. NTIS $4.50.

From IFIP symposium on computing methods in applied sciences and engineering; Paris, France (Dec 1973).

The determination of flows containing embedded shock waves over a wing in a stream moving at near sonic speed is considered on an isolated wing placed at an arbitrary yaw angle in a uniform free stream with prescribed Mach number at infinity. According to the Kutta condition the viscous effects cause the circulation at each span station to be such that the flow passes smoothly off the sharp trailing edge. The varying spanwise distribution of lift generates a vortex sheet that trails in the streamwise direction behind the trailing edge, and behind the side edge of the downstream tip. In practice the vortex sheet rolls up behind each tip and decays through viscous effects. A simplified model was used in which convection and decay of the sheet are ignored. Then the jump Γ in potential should be constant along lines parallel to the free stream behind the wing. Also the normal component of velocity should be continuous through the sheet. At infinity the flow is undisturbed except in the Trefftz plane far downstream, where there will be a two dimensional flow induced by the vortex sheet. (MCW)

26281 (JINR-P11-7345) GROUP AUTOMATA. Voikova, G. K.; Voikova, T. T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 11p. (In Russian). INIS.

26282 (LA-5584) STOCHASTIC/ANALOG SIMULATOR FOR VISCOUS, INCOMPRESSIBLE FLUID FLOW. Shipley, J. P. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-7405-eng-36. 12p. Dep. NTIS $4.00.

A restricted form of the simplified marker-and-cell (SMAC) algorithm for calculating incompressible fluid flows is described. The SMAC algorithm is suitable for hardware implementation. The necessary hardware for building a simulator is discussed in terms of block diagrams and cell circuitry. Such a simulator is feasible if stochastic processing techniques are used. Some cost estimates are given. (auth)

26283 (LA-UR-74-1110) OPTICAL DATA PROCESSING OF A HOLOGRAM OBTAINED WITH CODED APERTURE IMAGING. Han, K. S.; Berzins, G. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 6p. (CONF-740823-1). Dep. NTIS $4.00.

From 18th annual meeting of the Society of Photo-Optical Instrumentation Engineers; San Diego, California, USA (19 Aug 1974).

Spatial filtering techniques are used to enhance images reconstructed from coded aperture holograms. Emphasis is placed on removing background due to defocussed components (i.e., those corresponding to longitudinally displaced object planes) in the image. Preliminary experimental results are presented. Criteria for using an image reconstruction system as an optical data processing system are discussed. (auth)

26284 (LBL-2137) USE OF INTENSE SUB-MICROSECOND ELECTRON BURSTS TO PRODUCE ROCK SHATTERING. Avery, R. T.; Keefe, D.; Brekke, T. L.; Finnie, I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1 Jan 1974. Contract W-7405-eng-48. 6p. (CONF-740909-1). Dep. NTIS $4.00.

From 3rd international congress on rock mechanics; Denver, Colorado, USA (1 Sep 1974).

It has been demonstrated that intense sub-microsecond bursts of very-high-energy (≥1 MV) electrons cause significant pulverization and surface spalling of a variety of rock types, both wet and dry, and even moist clay. In general, for the same energy input, soft rocks show greater spall volume than hard rocks and wet rocks exhibit greater spall volume than dry rocks. The spall debris is of fine nature, being either dust, sand or small flakes. Selected test results are presented together with discussion of the fracture mechanisms occurring on this very short time-scale. Possible applications in tunneling and mining are briefly described. (auth)

26285 (LBL-2242) TRANSPORT PROCESSES IN HIGH RATE ELECTROLYSIS. Acosta, R. E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 212p. Dep. NTIS $13.75.

Thesis.

Rates of mass transport to planar electrodes imbedded into closely spaced walls (0.2 to 0.5 mm) of flat rectangular channels were determined by the limiting current technique. The nickel electrodes, on which ferric cyanide was reduced to ferrous cyanide, were subdivided into four electrically insulated segments, allowing for the determination of decline of transport rates in the direction of flow. The electrode surfaces were polished to optical smoothness, or provided with well defined roughness patterns. Friction factors were obtained by measurement of pressure drop between four positions in the hydrodynamic entrance region, and four in the mass transport section. (MCW)

26286 (LFEN-153(B)) SOLIDS MIXING IN LIQUID FLUIDIZATION. Carlos, C. R. (Junta de Energia Nuclear, Sacavem (Portugal). Lab. de Fisica e Engenharia Nucleares). 1973. 19p. (CONF-730460-2). Dep. NTIS (US Sales Only) $4.00.

From international congress on the use of electronic calculators in the field of chemistry; Paris, France (25 Apr 1973).

Consideration is given to the application of computerized numerical methods for the solution of a typical chemical engineering problem, the movement of solid particles fluidized by a liquid. This example is used to illustrate the potentiality and the limitations of such procedures for the study of transport phenomena. (auth)

26287 (MLM-2149(OP)) FLUIDIC NONCONTACT GAGING. Schurman, W. R. (Mound Lab., Miamisburg, Ohio (USA)). 1974. Contract AT(33-1)-GEN-53. 33p. (CONF-740902-1). Dep. NTIS $4.75.

From state-of-the-art symposium on fluidics; Adelphi, Maryland, USA (30 Sep 1974).

A fluidic noncontact method of gaging using low pressure air (less than 1 psig) was developed for measuring compacted powder heights of loaded detonators. Conventional air gages which used air flow indicators and back pressure sensors were investigated; however the minimum recommended operating pressure of 5 psig of gages of this type would disturb the compacted powder surface. Two gaging systems using extremely low back pressures coupled with a fluidic logic network were built and evaluated. Maximum sensing pressure and optimum gaging distance were established. Tooling for gaging the compacted powder heights for two different loaded detonators was developed. The relationship of back pressure and powder heights was determined over a 0.003 in. range. One fluidic gage was outfitted with a five-stage proportional amplifier. Another gage used fluidic indicator lights to indicate parts which were in tolerance, above tolerance, or below tolerance. The gages were also outfitted with a precision pressure transducer and digital display graduated in 0.001 psig divisions for obtaining actual back pressure readings. Other applications that could take advantage of gaging and sensing at extremely low pressures as they apply to detonator fabrication were also investigated. (auth)

26288 (MLM-CF-67-9-129) NEW PARTICLE-SIZE ANALYSIS SYSTEM. Mohler, J. H. (Mound Lab., Miamisburg, Ohio (USA)). 16 May 1967. Contract AT-33-1-GEN-53. 13p. Dep. NTIS $4.00.

Declassified 31 Dec 1972.

A system was assembled which uses a multichannel pulse-height analyzer to measure, display, and readout particle size distribution. Experiments were performed which indicated that a pulse produced by a particle passing through the detector is stored in the channel whose address is proportional to the volume of that particle. A computer program was written which will calculate the important parameters of the volume, specific surface area, and diameter distributions. All measurements are relative and a method of measurement should be selected that gives results which bear a consistent relation to the variable to be controlled. If a consistent relation between one or more of the parameters of particle size distribution and test firing performance can be found, the value of the procedure will be well established with regard to explosives work. (auth)

26289 (NASA-SP-5908(05)) HAND TOOLS. A Compilation. (National Aeronautics and Space Administration, Washington, D. C. (USA)). [nd]. 26p. Dep. NTIS $1.00.

26290 (NASA-SP-5957(03)) ANALYTICAL TECHNIQUES AND INSTRUMENTATION. A Compilation. (National Aeronautics and Space Administration, Washington, D. C. (USA)). [nd]. 29p. Dep. NTIS $1.00.

26291 (NYO-2807-93) EFFECTS OF INTERFACIAL TENSION GRADIENTS ON THE MOTION OF DROPS AND BUBBLES. Saville, D. A. (Princeton Univ., N. J. (USA). Dept. of Chemical Engineering). [nd]. 34p. Dep. NTIS $4.75.

The motion of small drops and bubbles was examined within the context of a theory that takes account of surface tension gradients brought on by composition variations around the periphery of a drop or bubble. Two situations were examined for large Peclet numbers: an almost-freely-circulating interface and an almost-rigid interface. The theory predicts a fairly rapid transition between these two states as the radius is decreased. Furthermore, the internal circulation patterns are asymmetric with the internal toroidal eddy shifted towards the front of the drop, in agreement with experimental observations. A comprehensive theory is also developed for situations where the Peclet number is small. (auth)

26292 (NYO-3406-1) SENSITIVITY OF IMAGE INTENSIFIER-FILM SYSTEMS FOR OBSERVING WEAK LIGHT SOURCES. Technical Report No. 1. Reynolds, G. T.; Botos, P. Princeton Univ., N. J. (USA)). 15 Feb 1965. Contract AT(30-1)-3406. 30p. Dep. NTIS $4.50.

A representative systematic evaluation of an image intensifier-film system is described. The important parameters of tube gain, cathode efficiency, noise, film sensitivity, image quality, and sign-to-noise ratio are discussed. The tube was a transmission secondary electron type and the process may be applied in biology, astronomy, and processes in which observation of weak light sources is desirable. (MCW)

26293 (NYO-3406-9) INTERFERENCE EFFECTS PRODUCED BY SINGLE PHOTONS. Reynolds, G. T.; Spartalian, K.; Scarl, D. B. (Princeton Univ., N. J. (USA). Palmer Physical Labs.; Polytechnic Inst. of Brooklyn, N. Y. (USA)). 1968. Contract AT(30-1)-3406. 19p. Dep. NTIS $4.00.

Interference patterns produced by low intensity photon beams passing through a Fabry – Perot interferometer were studied. Photons were detected by means of an image intensifier tube of high quantum detection efficiency. No change in the nature of the pattern was observed when the intensity of the beam was reduced from 5×10^4 to 15 photons per second in the entire pattern. (auth)

26294 (NYO-3406-12) X-RAY IMAGE INTENSIFICATION. Technical Report No. 8. Reynolds, G. T. (Princeton Univ., N. J. (USA)). 25 Nov 1968. Contract AT(30-1)-3406. 25p. Dep. NTIS $4.25.

26295 (RISO-M-1729) OPERATOR'S DIAGNOSIS TASK UNDER ABNORMAL OPERATING CONDITIONS IN INDUSTRIAL PROCESS PLANT. Goodstein, L. P.; Pedersen, O. M.; Rasmussen, J.; Skanborg, P. Z. (Danish Atomic Energy Commission, Risoe. Research Establishment). 20 Jun 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

Analysis of serious accidents in connection with the operation of technical installations demonstrate that the diagnosis task that confronts operations personnel under non-normal plant conditions is a critical one. A preliminary outline of characteristic traits connected with the task of diagnosis for use in discussions of (a) the studies that are necessary in order to formulate the operator's diagnostic procedures and (b) the possibilities that exist for supporting these procedures through appropriate data processing and display in the control system is reported. Attempts are made to connect ideas for display that currently are under consideration in the department to various phases of the diagnostic task which in itself is postulated as being divided into a sequence of subtasks each with its own typical features. (auth)

26296 (SAND-74-0130) MARS PENETRATOR; SUBSURFACE SCIENCE MISSION. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 209p. Dep. NTIS $13.50.

A penetrator system designed by Sandia Laboratories to emplace subsurface instruments on the planet Mars is described. The need for subsurface science is discussed, and the technologies for achieving successful atmospheric entry, Mars penetration, and data retrieval are presented. (auth)

26297 (SAND-74-5048) DAVIS GUN PENETRATOR LAUNCH SYSTEM. Seamons, L. O. (Sandia Labs., Albuquerque, N. Mex. (USA)). 15 Aug 1974. 14p. Dep. NTIS $4.00.

Interest in experimenting with large high velocity vehicle penetration of in-situ undisturbed earth targets has culminated with a new test facility, the Davis Gun Penetrator Launch System. The

launch system is a trailer-mounted gun. The trailer provides mobility and doubles as a gun mount and gun elevation mechanism. The Davis Gun is a special type of recoilless gun and fires test vehicles downwards into earth targets only a few feet away. The advantages of the Davis Gun over other candidate guns resulted in its selection for the facility. (auth)

26298 (SAND-74-5049) EXTENSION OF CONTROL TECHNIQUES FOR DIGITAL CONTROL OF RANDOM VIBRATION TESTS. Tebbs, J. D.; Smallwood, D. O. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 25p. (CONF-741006-2). Dep. NTIS $4.25.

From 45th shock and vibration symposium; Dayton, Ohio, USA (22 Oct 1974).

The basic control algorithm for digitally controlled random vibration tests can be expanded to include more complex test requirements than the single control channel test. Three control techniques (averaging, random-on-random, and response limiting) that were implemented and tested show the flexibility of digital control to adapt to new testing requirements without hardware reconfigurations. (MCW)

26299 (SAND-74-5275) DESIGN AND OPERATING CHARACTERISTICS OF A BALLOON-BORNE VACUUM SYSTEM. Woods, R. O. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 15p. (CONF-740914-2). Dep. NTIS $4.00.

From 8th APCRL scientific balloon symposium; Hyannis, Massachusetts, USA (30 Sep 1974).

Many instruments used for atmospheric research require vacuum pumps. Such pumps typically expend amounts of electrical energy that are large by ballooning standards or depend upon systems that operate only for limited times after being separated from their supplies of cryogenic liquids. In relatively low-altitude experiments it is possible to fly enough weight (batteries of cryogenic reservoir capacity) to support laboratory style vacuum pumps. This has been done successfully by earlier experimenters. At higher altitudes, particularly when flight times on the order of days are planned, use of conventional laboratory hardware ceases to be practical. A vacuum pump that was specifically intended for use in balloon experiments at altitudes approaching 50 kilometers is described. In addition to light weight, the system was designed for a prolonged liquid nitrogen holding time and an unusually high intermittent pumping speed. It differed in several important respects from pumps of the conventional laboratory configuration. (auth)

26300 (SAND-74-5355) MEASUREMENTS OF THE CHARGE DISTRIBUTIONS ON AN ALUMINA INSULATOR IN VACUUM RESULTING FROM HIGH-VOLTAGE STRESS. Brainard, J. P.; Jensen, D. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 15p. (CONF-741008-1). Dep. NTIS $4.00.

From conference on electrical insulation and dielectric phenomena; Downington, Pennsylvania, USA (21 Oct 1974).

The surface charge distribution remaining on an insulator in vacuum after a high-voltage pulse is in good agreement with the calculated charge distribution predicted by avalanche theory. The calculated value indicates that, for the diode geometry employed, the electric field generated by the surface charge intersects the surface at an angle of 16°. (auth)

26301 (SLA-74-0302) FRINGING FIELDS IN KERR CELLS. Thacher, P. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 61p. Dep. NTIS $6.25.

Fringing fields lead to pronounced optical effects when a nitrobenzene-filled Kerr cell is observed between crossed polarizers. Such effects must be considered or eliminated in using Kerr cells for measurement of pulsed high voltage, and these effects also influence the use of Kerr cells for light shutters or digital light deflectors. Calculations of both the fringing fields and their resultant optical effects are made assuming the electrodes have the shape of a Rogowski contour. These calculations agree well with experimental observation. For a ray centered between the electrodes, the effective length of the Kerr cell is found to be $l(1 + t/l\pi)$, where l is the electrode length and t the electrode separation. Corrections are also obtained when the ray is displaced vertically from the center towards an electrode and when the ray is displaced horizontally. These corrections are shown to hold when the electrode length and width (w) obey $l \geq w \geq 2t$ and when the container walls of the Kerr cell are greater than 2t from the electrode ends and sides. An optical technique is also developed that can be used either to eliminate or to measure the effect of fields fringing from the electrode ends. This technique is useful for the usual non-Rogowski electrodes as well as during dc calibration of the Kerr cell. (auth)

26302 (SLL-74-0015) LAUNCH AND ACCELERATION ENVIRONMENT TESTING: SYSTEMS TEST LABORATORY, SANDIA LABORATORIES. Spivey, L. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 28p. Dep. NTIS $4.50.

The utility of the high-performance centrifuge is demonstrated in connection with the testing of two payloads flown in the FY74 Sandia/ABRES Material Study (SAMS) test program. The test results indicate the importance of a facility capable of closely simulating flight environments. (auth)

26303 (UCID-15368) INTRINSICALLY SAFE CIRCUIT PROTECTOR FOR THERMOCOUPLE CIRCUITS. Souza, W. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1968. Contract W-7405-eng-48. 19p. Dep. NTIS $4.00.

An intrinsically safe circuit protector for thermocouple circuits was designed, built, and tested. The circuit will allow the safe use of thermocouples with an open, patch-panel type system in both Class I and Class II hazardous areas. Thus, a system can be constructed that is far more functional and flexible than would be possible with a sealed, permanently wired conduit system. (auth)

26304 (UCID-15379) ANALYTICAL GUIDELINES FOR NONDESTRUCTIVE MAGNETIC PULSE TESTING EXPERIMENTS. Latter, G. I. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Sep 1968. 68p. Dep. NTIS $6.50.

Methods are given for calculating stress as a function of field strength for plates, composite plates, and composite spheres. Computer programs are given for calculating maximum deflections, velocities, and accelerations of composite flat plates and composite spheres. From such information, the stresses in the composite bodies can be calculated. Also included is an algorithm from which a program can be written to calculate the stresses on a flat plate of a single material under an applied impulsive magnetic field. (auth)

26305 (UCID-15436) INFRARED TELEMETRY SYSTEM. Mather, G.; Greiner, D. B.; Horning, R. R.; Rufer, R. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Mar 1967. Contract W-7405-eng-48. 19p. Dep. NTIS $4.00.

The electro-optical telemetry system described is capable of transmitting information over a bandwidth of 30 Hz to 6 MHz with a signal-to-noise power ratio of better than 10:1, and a transmission path of greater than 2500 feet. The system is being used presently at LRL to transmit closed-circuit television (audio and video) over a 2200-foot path. An automatic gain control circuit is incorporated in the system to compensate for signal variations induced by the optical transmission path. (auth)

26306 (UCID-15466) HIGH-TEMPERATURE STRAIN DETERMINATIONS WITH THE MOIRE TECHNIQUE. Prado, M. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1969. 15p. Dep. NTIS $4.00.

The moiré technique for strain measurements makes use of two grids — one bonded to the surface of the specimen and the other located between the specimen and a camera that makes photographs of the combined images. As the specimen is strained its grid is distorted, producing moiré patterns or fringes on the film that can be measured to accurately determine the amount of strain in the specimen. Work done in developing and evaluating the moiré technique for use in high-temperature strain measurements is described. In a direct comparison the moiré technique gave more accurate strain measurements than the conventional extensometer technique in the elastic range and in the latter part of the plastic deformation area of the stress-strain curve. Specimens tested were stainless steel and copper. (auth)

26307 (UCID-15471) THOUGHTS ON CABLES. Jorgensen, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Mar 1967. 22p. Dep. NTIS $4.25.

The determination of τ in cable situations is discussed. The most used equation is: $\tau^{\frac{1}{2}} = AL \times 10^{-7}$ where L is the cable length in feet. "A" is obtained from the equation: $A = 5.758/\sqrt{\pi f} \times D.B./100$ feet where f is the frequency in MHz and the DB per 100 ft. at "f" frequency. Directions are given for determining τ for composite cables. Two illustrations are given: an input and an output signal of the alpha type and a narrow pulse of a general Gaussian type that differs from a Gaussian type in the lower half of the back side. This pulse is assumed to have an approximate full width at half max of 8 nsec. The cable assumed has a $\tau = 2.4$. The output pulse is the result of Gaussian input of 8 nsec full width at half max and the cable of τ of 2.4. (MCW)

26308 (UCID-15518) VISCOUS FLOW IN A RECTANGULAR CHANNEL HEAT PIPE WICK. Janssen, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1966. 9p. Dep. NTIS $4.00.

26309 (UCID-15521) HEAT PIPE OPTIMIZATION. Cheung, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Dec 1967. 15p. Dep. NTIS $4.00.

In existing analytical procedures for determining the optimum geometry and performance of heat pipes, certain simplifying assumptions have been made. This note assesses the error incurred in these assumptions by comparing the results of the analytical procedure with those of an exact numerical method. The differ-

ence in heat pipe performance predicted by the two methods is about 25%. (auth)

26310 (UCID-15552) PASSPORT PROGRAM QUARTERLY TECHNICAL PROGRESS SUMMARY NUMBER 8, JULY–SEPTEMBER 1969. Salisbury, J. D.; Gustavson, M. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1969. 17p. Dep. NTIS $4.00.

Technical progress on development of the Geographic Position Locator (GPL) System for the July–September 1969 quarter is reported. The information presented includes the efforts of LRL, the MIT Instrumentation Laboratory, the Analytic Sciences Corporation (TASC), and Litton Industries. Among the topics covered this quarter are thermal control systems, gyro-biasing schemes, LTN-51 dynamic test results, and gimbal configurations. (auth)

26311 (UCID-15560) SOME APPLICATIONS OF HOLOGRAPHY TO EXPERIMENTAL MECHANICS. Holloway, D. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Nov 1969. 17p. Dep. NTIS $4.00.

Holographic interferometry applied in the field of experimental mechanics is examined. Deformation-and-flaw measurements were performed on a Fiberglas-wound shell and a clamped aluminum disk. The flow of helium through a diffusing material also was studied. (MCW)

26312 (UCID-15582) USE OF A LINEAR TAPERED SECTION IN MEASUREMENT OF IMPEDANCE AND ATTENUATION. Bostwick, W. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Dec 1969. 21p. Dep. NTIS $4.25.

Measurement of impedance and attenuation of devices having 100-ohm connectors, using, for the most part, 50-ohm test instruments is discussed. The transition from 50 to 100 ohms was made with a linear tapered section. Impedance measurement by the method described involves some rather non-orthodox procedures. For this reason, the work on impedance measurements may possibly be properly called exploratory. Use of the tapered section for attenuation measurements did not appear to present any problems. (auth)

26313 (UCID-15582(Rev.1)) USE OF A LINEAR TAPERED SECTION IN MEASUREMENT OF IMPEDANCE AND ATTENUATION. Bostwick, W. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Dec 1969. 36p. Dep. NTIS $5.00.

26314 (UCID-15595) SIMPLE METHOD FOR DETERMINING THE UNIAXIAL ANISOTROPY DIRECTION AND SKEW IN MAGNETIC THIN FILMS. Hsieh, E. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1970. 5p. Dep. NTIS $4.00.

A new method was developed for determining the uniaxial anisotropy directions in magnetic thin films without active electronic instruments. The method, which can also be used to examine gross variations in anisotropy directions of the film, is based on the relaxation property of spins when a radial field is applied. (auth)

26315 (UCID-15615) PHOTON FILL-TIME OF AN OPTICAL CAVITY CONTAINING A GAIN MEDIUM. Jalbert, J. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Mar 1970. 8p. Dep. NTIS $4.00.

The delayed rise-time response of an optical cavity to a step function of optical input is termed photon fill-time. This delayed response is due to the superposition of multiple partial transmissions, each separated by the round trip photon transit time between the étalons. The photon fill-time of a Fabry–Perot spectrometer was previously developed. The response time enhancement of such a cavity when a gain medium is introduced between the étalons is determined. (auth)

26316 (UCID-15619) RECOMMENDED PRACTICE FOR BUTT TENSILE TESTING OF ADHESIVES AT LRL. Peck, L. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Apr 1970. 23p. Dep. NTIS $4.25.

26317 (UCID-15674) EMPIRICAL EQUATION OF STATE FOR SHOCK-VAPORIZED SOLIDS. Pelsor, G. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1970. 34p. Dep. NTIS $4.75.

26318 (UCID-16551) CONTROLLED BLASTING CALCULATIONAL STUDIES. Progress Report. Snell, C. M.; Heusinkveld, M.; Bryan, J. B.; Burton, D. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jun 1974. Contract W-7405-eng-48. 35p. Dep. NTIS $4.75.

Computer calculations were conducted for cylindrical explosive charges in three different types of rock. Since data on the properties of commercial explosives were inadequate, extensive detonation tests were undertaken to characterize four typical formulations. Properties of the rock media were chosen to match the dense high-strength materials often encountered in field blasting. Calculations were performed for both one-dimensional and two-dimensional cylindrical symmetry. The one-dimensional calculations model free-field shock transmission and rock fracturing, thereby enabling effectiveness comparisons for the various explosives. Two-dimensional calculations simulate realistic blasting events, with a vertical cylinder of explosive emplaced beneath a horizontal free surface. The two-dimensional configurations were used to study more sophisticated design techniques, including directional detonation of the explosive charge (top or bottom initiation), effects of an inclined presplit or fracture plane in the rock, and shock wave attenuation by a buffer zone of broken rock. Results of these calculations provide new insight into the overall dynamics of the blasting process. (MCW)

26319 (UCID-16574) THIN FILM EVAPORATION-THEORY. Van Sant, J. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 May 1970. Contract W-7405-Eng-48. 27p. Dep. NTIS $4.50.

26320 (UCRL-75499) MAGNETIC ORDER IN CERTAIN ALKALI AMPHIBOLES, A MOESSBAUER INVESTIGATION. Borg, R. J.; Borg, I. Y. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jul 1974. 28p. (CONF-740905-1). Dep. NTIS $4.50.

From international conference on the applications of the Moessbauer effect; Bendor, France (2 Sep 1974).

The appearance of magnetic hyperfine splitting (mhfs) has been used to determine the magnetic ordering temperature for a few selected alkali amphiboles. This class of minerals has the monoclinic crystal structure and the general formula $(Na, Ca)_{2-3}(Fe^{+2}, Fe^{+3}, Mg, Al)_5 Si_8O_{22}(OH, F)_2$. The iron can occupy three distinct crystallographic sites, yet the mhfs collapses with increasing temperature in the manner of less complex magnetic substances. In spite of the overall complexity, the much greater mhfs of Fe^{+3} easily separates lines 1 and 6 from all resonant absorption due to Fe^{+2}. Thus, relevant Moessbauer and magnetic parameters can be determined. The temperature dependence of the mhfs departs substantially from the usual Brillouin-like function. Magnetic susceptibility data on one sample indicate that the ordering is antiferromagnetic. The stacking sequence formed by the three sites is a one-dimensional chain parallel to the c axis. Each chain is separated from adjacent chains by linked SiO_4 tetrahedra. Thus, direct exchange can only occur within the chain, and a type of super-exchange must exist between the chains. (auth)

26321 (UCRL-75645) LIMIT OF ACCURACY OF MACHINE TOOLS. Bryan, J. B.; Loewen, E. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Apr 1974. 13p. (CONF-740825-1). Dep. NTIS $4.00.

From international conference on production engineering; Tokyo, Japan (26 Aug 1974).

Accuracy of a machine tool is determined by four factors: (1) attitude of the user, (2) production volume, (3) workpiece material, and (4) the specific accuracy parameter required such as roundness or size. Continuing advancements will take place in the accuracy of machine tools since there appears to be no technological barrier of a universal nature. Benefits arising from improved accuracy, such as longer life of product, advancement in basic science, and improved interchangeability will continue to provide the necessary incentives. (auth)

26322 (UCRL-75706) ELECTROOPTICAL SCANNER FOR MONITORING ELECTRON BEAM WELDS. Gillespie, C. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jul 1974. 8p. (CONF-741014-1). Dep. NTIS $4.00.

From Instrument Society of America conference; New York, New York, USA (28 Oct 1974).

An electrooptical scanner has been developed to monitor the quality of an electron beam weld while the weld is being made. The scanning monitor indicates how closely the beam is centered on the joint throughout the length of the weld and provides an indication of the uniformity of the weld by monitoring the light intensity across the weld puddle. The scanning monitor can be used in setting up and aligning the welder, and the oscilloscope display can be photographed to provide a permanent record of the weld. The parameters measured could also serve as input signals to an automatic control system in controlling the welder. (auth)

26323 (UCRL-73737) TECHNIQUES TO ACHIEVE SEMICONDUCTOR RELIABILITY IN UNIQUE POWER EQUIPMENT. Smith, B. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jun 1974. 15p. (CONF-740657-1). Dep. NTIS $4.00.

From power electronics specialists conference; Murray Hill, New Jersey, USA (10 Jun 1974).

26324 (USC-113P-54) RESOLVENT OF MILNE'S INTEGRAL EQUATION FOR A SPHERICAL ISOTROPICALLY SCAT-

TERING MEDIUM. Technical Report No. 73-20. Ueno, S. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). May 1973. Contract AT(04-3)-113. 10p. Dep. NTIS $4.00.

Recently, determination of the resolvent kernel of Milne's integral equation for a spherical isotropically scattering medium with internal sources has been made. It is shown how to compute the resolvent kernel of the above Milne's equation in terms of the modified Sobolev's Φ function, which is reduced to the angular integration of the source function in the diffuse radiation field by a finite slab. In other words, once X and Y functions of a slab with two times optical radius of the sphere have been computed and a Cauchy system for the source function has been solved, the resolvent kernel under consideration can be determined by integration of the modified Sobolev's Φ function. (auth)

26325 (USC-113P-55) INVARIANT IMBEDDING, ITERATIVE LINEARIZATION AND MULTISTAGE COUNTERCURRENT PROCESSES. VIII. Estimation of Minimum Reflux and Multipoint Boundary Value Problem. Technical Report No. RB 73-21. Lee, E. S. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). May 1973. Contract AT(04-3)-113. 13p. Dep. NTIS $4.00.

The problem of estimating the minimum reflux ratio is treated as a nonlinear multipoint boundary value problem in difference equations. If the problem has a solution, the minimum reflux ratio and the compositions in the column are obtained simultaneously by quasilinearization iteration. With very rough initial approximations or starting values, only nine iterations are needed to obtain a four digit accuracy in concentration. A three digit accuracy in distillate rate is obtained in seven iterations. (auth)

26326 (USC-113P-60) GENERALIZED SOBOLEV's PHI FUNCTION FOR THE RESOLVENT OF A MILNE-TYPE INTEGRAL EQUATION WITH A DEGENERATE KERNEL. Technical Report No. RB73-30. Ueno, S. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Jul 1973. Contract AT(04-3)-113. 16p. Dep. NTIS $4.00.

It is well-known in the field of radiative transfer that Sobolev was the first to introduce the resolvent into Milne's integral equation with a displacement kernel. Thereafter it was shown that the resolvent plays an important role in the theory of formation of spectral lines. In the theory of line-transfer problems the kernel representation in Milne's integral equation has been used to provide an approximate solution in a manner similar to that given by the discrete ordinates method. In this paper, by means of invariant imbedding, it is shown how to determine an exact solution of a Milne-type integral equation with a degenerate kernel whose form is more general than the Pincherle–Gourast kernel. A Cauchy system for the resolvent is expressed in terms of generalized Sobolev's Φ and Ψ functions, which are computed by solving a set of differential equations for auxiliary functions. Furthermore, these functions are expressed in terms of components of the kernel representation. (auth)

26327 (USC-113P-67) NOVEL APPROACH TO THE STUDY OF REFLECTION FUNCTIONS FOR FINITE ISOTROPICALLY SCATTERING ATMOSPHERES BOUNDED BELOW BY SPECULAR AND LAMBERT LAW REFLECTORS. Technical Report No. RB73-40. Bellman, R.; Vasudevan, R.; Farah, J. (University of Southern California, Los Angeles (USA)). Jul 1973. Contract AT(04-3)-113. 27p. Dep. NTIS $4.50.

A novel method of obtaining the reflection function for a medium bounded below by an imperfect specular reflector is detailed by considering the equivalent processes taking place in a fictitious medium with only absorbing boundaries. This medium is endowed with suitable properties and of twice the optical thickness as the original one. Equivalence relations for the various transfer functions of the two media are established. A similar analysis of transfer processes in a medium bounded by a Lambert law reflector is also carried out. A possible method of comparing the reflector albedoes of a medium bounded below by different Lambert law reflectors employing the cross ratio theorem of Riccati equations is also briefly mentioned. (auth)

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